[Volume I, Appx00001 – Appx00316]

Nos. 22-2069, -2070, -2071, -2072

IN THE

United States Court of Appeals

FOR THE FEDERAL CIRCUIT

MASIMO CORPORATION,

Appellant,

v.

APPLE INC.,

Appellee.

APPEAL FROM THE PATENT TRIAL AND APPEAL BOARD
CASE NOS. IPR2021-00193, IPR2021-00195, IPR2021-00208, IPR2021-00209

JOINT APPENDIX

Joseph R. Re, *Principal Counsel*
Stephen C. Jensen
Jarom D. Kesler
Stephen W. Larson
KNOBBE, MARTENS, OLSON & BEAR, LLP
2040 Main Street, 14th Floor
Irvine, CA 92614
(949) 760-0404

Jeremiah S. Helm
KNOBBE, MARTENS, OLSON & BEAR, LLP
1717 Pennsylvania Ave., N.W.
Washington, D.C. 20006
(202) 640-6400

Attorneys for Appellant Masimo Corporation

Lauren A. Degnan, *Principal Counsel*
Christopher Dryer
W. Karl Renner
FISH & RICHARDSON P.C.
1000 Maine Ave., Suite 1000
Washington, DC 20024
Tel: (202) 783-5070

Ashley Bolt
FISH & RICHARDSON P.C.
1180 Peachtree Street NE
21st Floor
Atlanta, GA 30309
Tel: (404) 892-5005

Attorneys for Appellee Apple Inc.

May 10, 2023

Table of Contents

Date	Paper No. /Ex. No.	Document	Pages
		[IPR2021-00193]	Appx01187-01189
3/8/2021	6	Apple Updated Exhibit List [IPR2021-00193]	Appx01283-01285
4/5/2022	29	Record of Oral Hearing on 3/15/2022 [IPR2021-00193]	Appx01704; Appx01717; Appx01731-01733
7/27/2022	31	Masimo Notice of Appeal to the U.S. Court of Appeals for the Federal Circuit [IPR2021-00193]	Appx01737-01739
	Ex. 1002	Excerpts from the Prosecution History of U.S. Patent No. 10,299,708 [IPR2021-00193]	Appx01828; Appx02085-02086
	Ex. 1003	Declaration of Dr. Thomas W. Kenny [IPR2021-00193]	Appx02157; Appx02161; Appx02201-02212; Appx02230-02232; Appx02256-02266
VOLUME V			
	Ex. 1006	U.S. Pat. App. Pub. No. 2002/0188210 (Aizawa) [IPR2021-00193]	Appx02397-02403
	Ex. 1007	JP 2006-296564 Inokawa [IPR2021-00193]	Appx02404-02426
	Ex. 1008	Certified English Translation of Inokawa and Translator Declaration [IPR2021-00193]	Appx02427-02450
	Ex. 1014	U.S. Pat. App. Pub. 2001/0056243 (Ohsaki) [IPR2021-00193]	Appx02507-02512
	Ex. 1015	Mendelson 1988 - Design and Evaluation of a New Reflectance Pulse Oximeter Sensor [IPR2021-00193]	Appx02513-02519
	Ex. 1016	Mendelson 2006 - Wearable Reflectance Pulse Oximeter for	Appx02520-02521

Date	Paper No. /Ex. No.	Document	Pages
		Remote Physiological Monitoring [IPR2021-00193]	
	Ex. 1023	U.S. Pat. App. Pub. No. 2007/0145255 (Nishikawa) [IPR2021-00193]	Appx02598-02605
	Ex. 1025	U.S. Patent No. 6,801,799 (Mendelson) [IPR2021-00193]	Appx02610-2625
	Ex. 1047	Second Declaration of Thomas Kenny [IPR2021-00193]	Appx03558; Appx03560; Appx03562-3586
	Ex. 2004	Declaration of Vijay K. Madisetti, Ph.D. [IPR2021-00193]	Appx04781; Appx04811-4814; Appx04817-4823; Appx04829-4830; Appx04835-4839; Appx04843
	Ex. 2006	4/22/2021 Deposition Transcript of Dr. Thomas W. Kenny [IPR2021-00193]	Appx04884; Appx04934-4935; Appx04957-4960; Appx04966-4967; Appx04969-4973; Appx04976-4977; Appx04980; Appx04983-4984; Appx05015-5017; Appx05024-5026; Appx05037; Appx05047; Appx05062-5064; Appx05071-5073; Appx05081; Appx05085-5091; Appx05140
	Ex. 2007	4/23/2021 Deposition Transcript of Thomas W. Kenny [IPR2021-00193]	Appx05156; Appx05193-5194; Appx05214-5218;

Date	Paper No. /Ex. No.	Document	Pages
			Appx05224-5225; Appx05285; Appx05288
	Ex. 2008	4/24/2021 Deposition Transcript of Thomas W. Kenny [IPR2021-00193]	Appx05336; Appx05491-05492
	Ex. 2009	4/25/2021 Deposition Transcript of Thomas W. Kenny [IPR2021-00193]	Appx05602; Appx05682-05687
	Ex. 2027	9/18/2021 Deposition Transcript of Thomas W. Kenny [IPR2021-00193]	Appx06194; Appx06212-6215; Appx06242-6243; Appx06250; Appx06397-6398; Appx06406-6408; Appx06411-6412
11/20/2020	2	Petition for *Inter Partes* Review of U.S. Patent No. 10,376,190 [IPR2021-00195]	Appx06457; Appx06494-6495
3/8/2021	5	Apple Updated Exhibit List [IPR2021-00195]	Appx06572-6575
7/27/2022	33	Masimo Notice of Appeal to the U.S. Court of Appeals for the Federal Circuit [IPR2021-00195]	Appx07041-7043
	Ex. 1002	Excerpts of File History of U.S. Patent No. 10,376,190 (Poeze) [IPR2021-00195]	Appx07126; Appx07396-7397
	Ex. 1003	Declaration of Dr. Thomas W. Kenny [IPR2021-00195]	Appx07469; Appx07512-7520; Appx07532-7534; Appx07545-7547; Appx07570-7577
	Ex. 1047	Second Declaration of Thomas Kenny [IPR2021-00195]	Appx08873; Appx08877-08900
	Ex. 2004	Declaration of Vijay K.	Appx10097;

Date	Paper No. /Ex. No.	Document	Pages
		Madisetti, Ph.D. [IPR2021-00195]	Appx10127-10130; Appx10133-10141; Appx10147-10148; Appx10160-10161
	Ex. 2006	4/22/2021 Deposition Transcript of Dr. Thomas W. Kenny in IPR2020-01520 [IPR2021-00195]	Appx10205; Appx10401-10402; Appx10408; Appx10410
VOLUME VI			
	Ex. 2027	9/18/2021 Deposition Transcript of Dr. Thomas W. Kenny [IPR2021-00195]	Appx11515; Appx11533-11534
11/20/2020	2	Petition for *Inter Partes* Review of U.S. Patent No. 10,258,266 [IPR2021-00208]	Appx11778; Appx11796; Appx11815; Appx11825-11827; Appx11830-11831; Appx11836
3/8/2021	6	Apple Updated Exhibit List - [IPR2021-00208]	Appx11866-11868
7/27/2022	33	Masimo Notice of Appeal to the U.S. Court of Appeals for the Federal Circuit [IPR2021-00208]	Appx12237-12239
	Ex. 1002	Excerpts from the Prosecution History of U.S. Patent No. 10,258,266 [IPR2021-00208]	Appx12320; Appx12582-12584
	Ex. 1003	Declaration of Dr. Thomas W. Kenny [IPR2021-00208]	Appx12697; Appx12731-12747; Appx12753-12754; Appx12765-12775
	Ex. 1010	U.S. Patent No. 8,177,720 (Nanba) [IPR2021-00208]	Appx12968-12988
	Ex. 1047	Second Declaration of Thomas Kenny [IPR2021-00208]	Appx13759; Appx13763-13789
	Ex. 2004	Declaration of Vijay K.	Appx14985;

Date	Paper No. /Ex. No.	Document	Pages
		Madisetti, Ph.D. [IPR2021-00208]	Appx15012-15015; Appx15018-15026; Appx15032-15033; Appx15036-15037; Appx15039-15040; Appx15050-15051
11/20/2020	2	Petition for *Inter Partes* Review of U.S. Patent No. 10,376,191 [IPR2021-00209]	Appx16924; Appx16960; Appx16970-16972
3/8/2021	5	Apple's Updated Exhibit List [IPR2021-00209]	Appx17009-17011
7/27/2022	33	Masimo Notice of Appeal to the U.S. Court of Appeals for the Federal Circuit [IPR2021-00209]	Appx17359-17361
	Ex. 1002	Excerpts from the Prosecution History of U.S. Patent No. 10,376,191 [IPR2021-00209]	Appx17440; Appx17697-17699
	Ex. 1003	Declaration of Dr. Thomas W. Kenny [IPR2021-00209]	Appx17766; Appx17799-17816; Appx17822-17823; Appx17834-17845
	Ex. 1047	Second Declaration of Thomas W. Kenny [IPR2021-00209]	Appx18828; Appx18832-18858
	Ex. 2004	Declaration of Vijay K. Madisetti, Ph.D. [IPR2021-00209]	Appx20054; Appx20081-20084; Appx20087-20095; Appx20101-20102; Appx20105-20106; Appx20108-20110; Appx20120

57599545

Trials@uspto.gov
571-272-7822

Paper 30
Date: June 1, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2021-00193
Patent 10,299,708 B1

Before JOSIAH C. COCKS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges.*

KINDER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition (Paper 2, "Pet.") pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–29 ("challenged claims") of U.S. Patent No. 10,299,708 B1 (Ex. 1001, "the '708 patent"). We instituted the petitioned review (Paper 7, "Institution Decision" or "Inst. Dec.").

Masimo Corporation ("Patent Owner") filed a Patent Owner Response (Paper 14, "PO Resp.") to oppose the Petition. Petitioner filed a Reply (Paper 16, "Pet. Reply") to the Patent Owner Response. Patent Owner filed a Sur-reply (Paper 19, "Sur-reply") to the Reply. We conducted an oral hearing on March 15, 2022. A transcript has been entered into the record (Paper 29, "Tr.").

We have jurisdiction under 35 U.S.C. § 6(b)(4) and § 318(a). This Decision is a final written decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of claims 1–29 of the '708 patent. We determine Petitioner has shown by a preponderance of the evidence that those claims are unpatentable.

B. Related Matters

The parties identify the following matters related to the '708 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01716 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1)

Apple Inc. v. Masimo Corporation, IPR2021-00195 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,376,190 B1);

Apple Inc. v. Masimo Corporation, IPR2021-00208 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,258,266 B1); and

Apple Inc. v. Masimo Corporation, IPR2021-00209 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,376,191 B1).

Pet. 97–98; Paper 3, 3–4.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’708 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 17/031,407;

U.S. Patent Application No. 17/031,316;

U.S. Patent Application No. 17/031,356;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 3, 2–3.

C. The ’708 Patent

The ’708 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on May 28, 2019, from U.S. Patent Application No. 16/261,366, filed Jan. 29, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’708 patent claims priority

through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The ’708 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:31–33. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:22–28, 2:57–58. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:38–40.

Figure 1 of the ’708 patent is reproduced below.

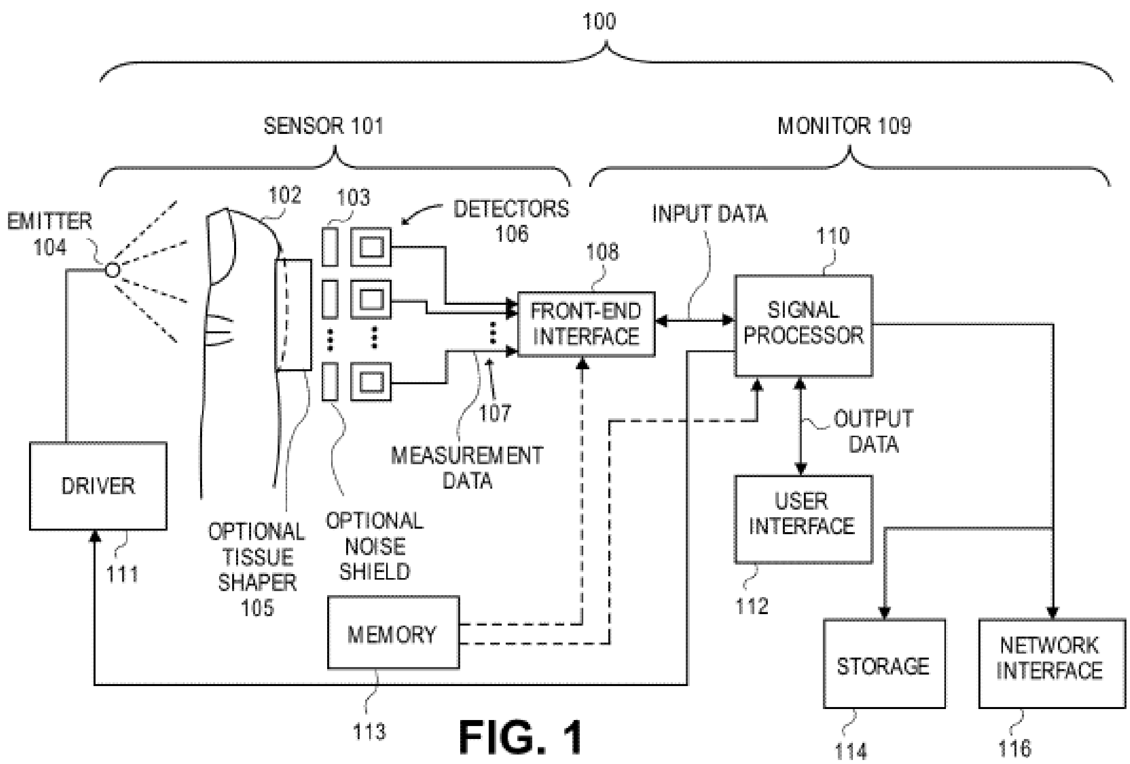


FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:36–47. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:48–52. Emitters 104 emit light that

is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 13:60–67. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 13:64–66, 14:16–22. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 10:61–11:3.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:6–8. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors." *Id.* at 15:10–14. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:38–48. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:52–16:3.

The '708 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate sensor devices.

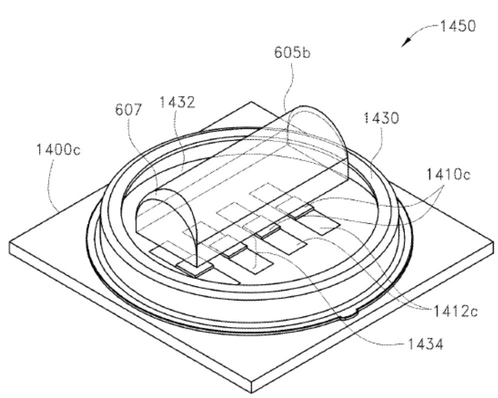


FIG. 14D

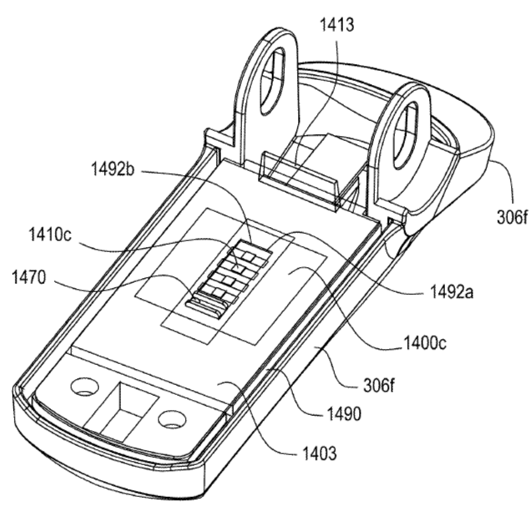


FIG. 14F

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:34–37. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:23–25, 36:17–24. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 36:63–37:4. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:34–36.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

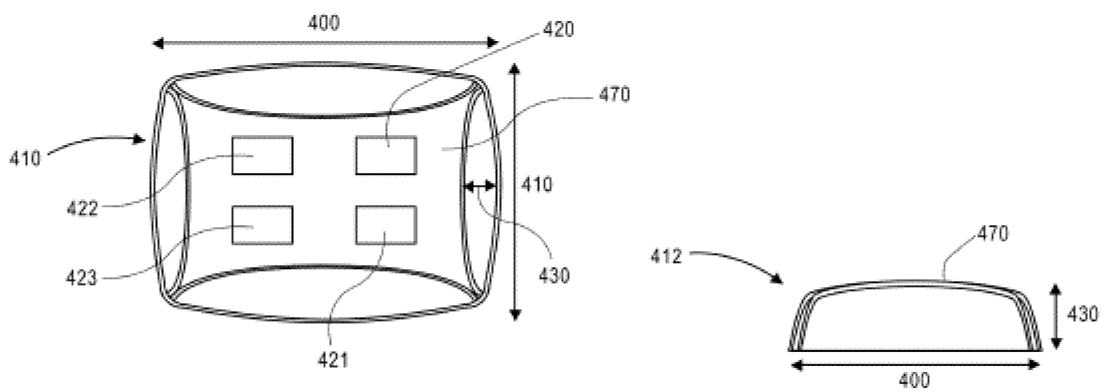


FIG. 4A FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:8–14. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:31–33. The measurement site contact area may include windows 420–

423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:39–53.

D. Illustrative Claim

Of the challenged claims, claims 1 and 19 are independent. Claim 1 is illustrative and is reproduced below.

> 1. A noninvasive optical physiological sensing system comprising:
>
> [a] a platform including a planar surface;
>
> [b] a housing including a raised edge portion extending from and enclosing at least a portion of the planar surface;
>
> [c] at least four detectors arranged on the planar surface of the platform and within the housing, wherein the at least four detectors are arranged in a grid pattern such that a first detector and a second detector are arranged across from each other on opposite sides of a central point along a first axis, and a third detector and a fourth detector are arranged across from each other on opposite sides of the central point along a second axis which is perpendicular to the first axis; and
>
> [d] the housing including a protruding light permeable cover.

Ex. 1001, 44:36–50 (bracketed identifiers [a]–[d] added). Independent claim 19 includes limitations similar to limitations [a]–[d] of claim 1 but also requires distinct limitations discussed more below. *Id.* at 45:53–46:11 (reciting a "platform," "at least four detectors," and a "light permeable cover . . . protruding above the raised wall").

E. Evidence Relied Upon

Petitioner relies on the following references:

Reference	Publication/Patent Number	Exhibit
Aizawa	U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002.	1006
Inokawa	Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006.	1007, 1008[1]
Ohsaki	U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001.	1014
Mendelson-2006	"A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006).	1016
Beyer	U.S. Patent No. 7,031,728 B2 issued April 18, 2006.	1019
Goldsmith	U.S. Patent Application Publication No. 2007/0093786 A1, filed July 31, 2006, published April 26, 2007.	1027
Lo	U.S. Patent Application Publication No. 2004/0138568 A1, filed June 15, 2003, published July 15, 2004.	1028
Mendelson-1988	"Design and Evaluation of a New Reflectance Pulse Oximeter Sensor," Worcester Polytechnic Institution, Biomedical Engineering Program, Worcester, MA 01609; Association for the Advancement of Medical Instrumentation, Vol. 22, No. 4, 1988, 167–173.	1015

Pet. 1–2.

Petitioner also relies on the declaration testimony of Thomas W. Kenny, Ph.D. (Exhibits 1003 and 1047). Patent Owner relies on the

[1] Exhibit 1008 is an English translation of Exhibit 1007.

declaration testimony of Vijay K. Madisetti, Ph.D. (Exhibit 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this and other proceedings. *See* Exs. 1034–1036, 2006–2009, 2027.

F. Asserted Grounds

We instituted an *inter partes* review based on the following grounds:

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–9, 11, 13–15, 19–22, 24–27	103	Aizawa, Inokawa
1–9, 11, 13–15, 19–22, 24–27	103	Aizawa, Inokawa, Ohsaki
16, 27, 28	103	Aizawa, Inokawa, Mendelson-2006
17, 18, 29	103	Aizawa, Inokawa, Mendelson-2006, Beyer
16–18, 27–29	103	Aizawa, Inokawa, Goldsmith, Lo
10	103	Aizawa, Inokawa, Al-Ali
1–9, 11–15, 19–26	103	Mendelson-1988, Inokawa
16, 27, 28	103	Mendelson-1988, Inokawa, Mendelson-2006
17, 18, 29	103	Mendelson-1988, Inokawa, Mendelson-2006, Beyer

II. ANALYSIS

A. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406

(2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information,

[2] The parties do not present objective evidence of non-obviousness based on the final record.

including but not limited to physiological monitoring technologies." Pet. 4–5 (citing Ex. 1003 ¶¶ 21–22). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.*

Patent Owner does not challenge using Petitioner's asserted level of skill, but notes that "asserted level of skill (1) requires no coursework, training or experience with optics or optical physiological monitors; (2) requires no coursework, training or experience in physiology; and (3) focuses on data processing and not sensor design." PO Resp. 9–10 (citing Pet. 4–5; Ex. 2004 ¶¶ 35–38).

We adopt Petitioner's assessment for the person of ordinary skill in the art ("POSITA") as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

C. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019). Although both parties contend that no claim term requires express construction (Pet. 4; PO Resp. 9), the substance of the parties' briefing demonstrates that there is a dispute regarding the claim term "cover."

1. "cover"

Each of independent claims 1 and 19 requires "a light permeable cover." Ex. 1001, 44:50, 46:10.

Patent Owner argues that the claimed "cover" excludes "an optically clear adhesive/epoxy" and a "resin on a surface." PO Resp. 45–47. According to Patent Owner, "the '708 Patent distinguishes a resin on a surface from a cover, explaining: 'the cylindrical housing 1430 (and transparent cover 1432) . . . can protect the detectors 1410c and conductors 1412c ***more effectively*** than currently-available ***resin epoxies***.'" *Id.* at 45 (quoting Ex. 1001, 36:37–46).

Patent Owner alleges that Dr. Kenny also "distinguished a sealing resin from a cover, acknowledging a 'layer of sealing resin' is 'one way to protect the components ***without using a cover***.'" *Id.* at 45–46 (quoting Ex. 2009, 395:22–396:17). Patent Owner argues its understanding is consistent with the prior art cited by Petitioner. *Id.* at 46 (citing Ex. 1008 ¶ 103, Fig. 17; Ex. 1023 ¶ 35; Ex. 1012, 5:2–6, Fig. 2B; Ex. 1013 ¶ 32, Fig. 2; Ex. 1027 ¶ 85, Fig. 9B; Ex. 2004 ¶ 104).

Petitioner replies that "there is nothing in the specification or the prosecution history [of the '708 patent] that would lead a [person of ordinary skill in the art] to conclude that 'cover' should be interpreted based on anything other than its plain meaning." Pet. Reply 21 (citing *Thorner v. Sony Computer Entertainment America LLC*, 669 F.3d 1362, 1368 (Fed. Cir. 2012)). That plain meaning, according to Petitioner, is that "a cover is merely 'something that protects, shelters, or guards.'" *Id.* at 21 (quoting Ex. 1050; citing Pet. 74–75; Ex. 1047 ¶ 43). Petitioner argues that Patent Owner's reliance on the '708 patent Specification takes text out of context and, when context is considered, it is clear that "the epoxy resin to which the '708 patent compares its cover is not [an] epoxy cover . . . but rather epoxy that is applied to solder joints." *Id.* at 21–22 (citing Ex. 1001, 36:37–46; Ex. 1047 ¶ 45).

Petitioner also contends that Patent Owner "mischaracterizes Dr. Kenny's deposition testimony to say he agreed that 'sealing resin' is somehow distinguished from a cover." *Id.* at 21. Petitioner contends that Dr. Kenny simply "clarified that using a sealing resin is 'a pretty common way to protect electronic components.'" *Id.* (citing Ex. 2009, 395:22–396:17; Ex. 1047 ¶ 44). Moreover, Petitioner contends that "such extrinsic evidence would not justify departure from plain meaning under *Thorner*." *Id.*

In its Sur-reply, Patent Owner maintains that the '708 patent "specifically ***distinguishes*** a 'resin' on a surface from a 'cover,'" and Petitioner's opposing reading is not persuasive. Sur-reply 19–21.

Upon review of the record, we disagree with Patent Owner's limiting construction of "cover" to exclude epoxy and resin. The plain and ordinary meaning of the term does not support Patent Owner's view. A "cover" ordinarily connotes "something that protects, shelters, or guards." Ex. 1050,[3] 288. That plain and ordinary meaning is consistent with the '708 patent's description of "flex circuit cover 360, which can be made of plastic or another suitable material . . . [and] can cover and thereby protect a flex circuit (not shown)." Ex. 1001, 22:63–65. It also is consistent with the '708 patent's description and illustration of "transparent cover 1432" in Figure 14D, which covers and protects detectors 1410c and conductors 1412c, and which "can be fabricated from glass or plastic, *among other materials*." *See id.* at 36:23–32 (emphasis added), Figs. 14D–14E.

This is not the situation in which a special definition for a claim term has been set forth in the specification with reasonable clarity, deliberateness,

[3] *Merriam-Webster's Collegiate Dictionary*, 11th ed. (©2005).

and precision, so as to give notice of the inventor's own lexicography. *See Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005); *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Nor do we discern that Patent Owner "demonstrate[d] an intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope." *Teleflex, Inc. v. Ficosa North America Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002).

Here, based upon our review of the intrinsic evidence, no such special definition or express disavowal of the term "cover" to exclude epoxy and resin exists. Patent Owner relies on the following description of Figure 14D in that regard:

> *In certain embodiments, the cylindrical housing 1430 (and transparent cover 1432)* forms an airtight or substantially airtight or hermetic seal with the submount 1400c. As a result, the cylindrical housing 1430 can protect the detectors 1410c and conductors 1412c from fluids and vapors that can cause corrosion. Advantageously, *in certain embodiments, the cylindrical housing 1430 can protect* the detectors 1410c and conductors 1412c *more effectively than currently-available resin epoxies*, which are sometimes applied to solder joints between conductors and detectors.

Ex. 1001, 36:37–46 (emphases added). First, the sentence cited by Patent Owner begins with the phrase "[i]n certain embodiments," which indicates the claimed invention is not limited and is open to other embodiments, so there is no lexicography or disavowal here. Second, we agree with Petitioner's reading of this passage as distinguishing the prior art from the claimed invention based on the *location* of the material (applied only to solder joints between conductors and detectors in the prior art, as opposed to covering the conductors and detectors in the invention) and not the *type* of

material. Third, at best, the ’708 patent expresses a preference for a cover to be made of glass or plastic, because such materials provide “more effective[]” protection than resin epoxies that were known when the ’708 patent was filed. *See id.* at 36:39–45. But even this reading recognizes that resin epoxies provide some amount of protection, albeit perhaps a lesser amount than glass or plastic, and are not excluded from forming the material of a cover.

Dr. Kenny’s deposition testimony cited by Patent Owner also does not persuade us that, in the context of the ’708 patent, epoxy or resin is excluded from the material of a cover. Dr. Kenny testifies that “a layer of sealing resin” “[c]ould” be used to protect the electronic components in a sensor (Ex. 2009, 395:22–396:8). He was then asked “So that would be one way to protect the components without using a cover, correct?” to which he answered “[t]here are many ways to protect the elements other than using a cover” and maintained that the proposed combination of prior art has a “cover” to achieve purposes *other than* protecting electronic components, i.e., “to improve adhesion and to improve light gathering for the operation of the system.” *Id.* at 396:9–17. He did not squarely testify that sealing resin may never be a cover.

Accordingly, in the context of the ’708 patent, we do not construe the claimed “cover” to exclude epoxy and resin.

2. Other Claim Terms

Upon consideration of the entirety of the arguments and evidence presented, we conclude no further explicit construction of any claim term is needed to resolve the issues presented by the arguments and evidence of record. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*

Matal, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (per curiam) (claim terms need to be construed "only to the extent necessary to resolve the controversy" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Obviousness over Aizawa and Inokawa

Petitioner contends that claims 1–9, 11, 13–15, 19–22, and 24–27 of the '708 patent would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 7–40.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor worn on a user's wrist that detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

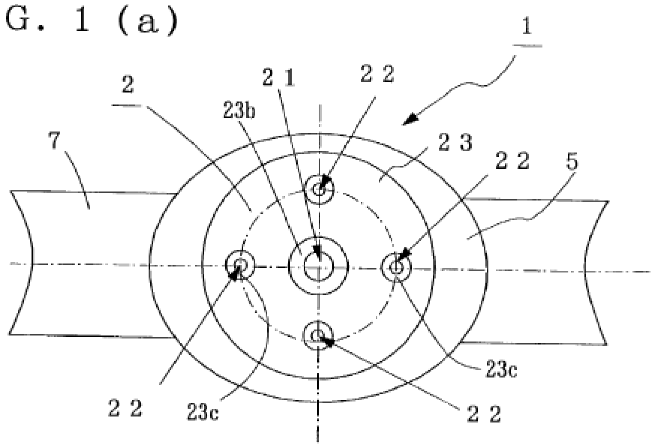


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses

that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

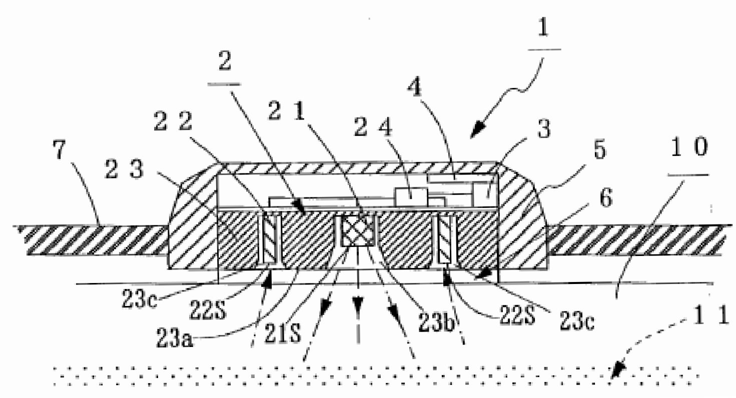


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.*

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.*

Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)." *Id.* ¶ 26. Acrylic transparent plate 6 is disposed between holder 23 and the user's wrist 10. *Id.* ¶¶ 23, 26, 30. Furthermore, "belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10." *Id.* ¶ 26. "Since the acrylic transparent plate 6 is provided on the detection face 23a of the holder 23, adhesion between the pulse rate detector 1 and the wrist 10 can be improved, thereby further improving the detection efficiency of a pulse wave." *Id.* ¶ 30.

2. Overview of Inokawa (Ex. 1008)

Inokawa is a Japanese published patent application titled "Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method," and discloses a pulse sensor device that may be worn on a user's wrist. Ex. 1008, code (54), ¶ 56.[4]

[4] Exhibit 1008 is an English translation of Exhibit 1007. In this Decision, all citations are to the English translation.

Figure 1 of Inokawa is reproduced below.

(FIG. 1)

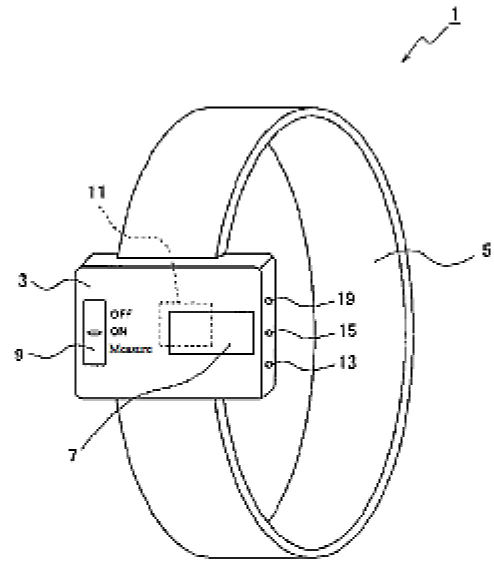


Figure 1 illustrates a perspective view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user's pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

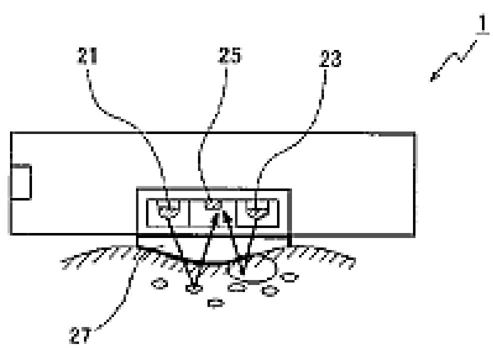


Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of

light-emitting elements, i.e., green LED[5] 21 and infrared LED 23, as well as photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 senses "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 senses body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory." *Id.* ¶ 69.

Pulse sensor 1 includes lens 27, which "makes it possible to increase the light-gathering ability of the LED as well as to protect the LED or PD[6]." *Id.* ¶¶ 15, 58. Pulse sensor 1 also uses LEDs 21 and 23 to download data to a base station, as shown in Figure 3, reproduced below.

[5] We understand "LED" to be an acronym for "light emitting diode."
[6] We understand "PD" to be an acronym for "photodiode."

(FIG. 3)

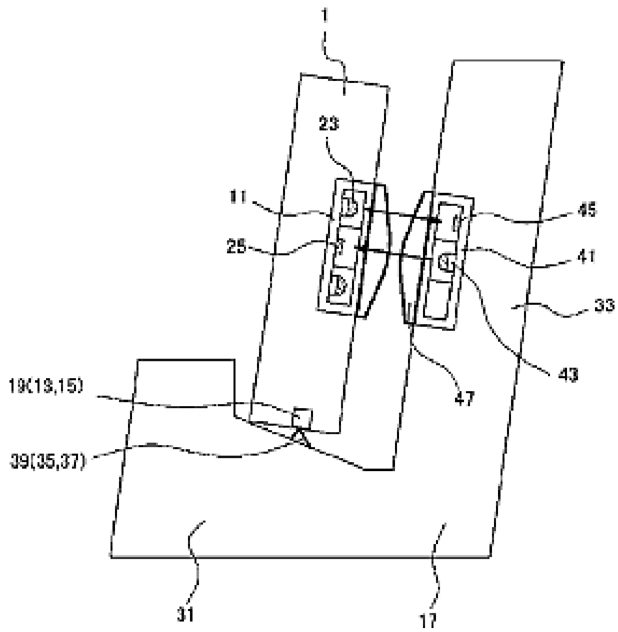


Figure 3 illustrates a schematic view of a pulse sensor mounted to a base device. *Id.* ¶ 60. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* When so mounted, sensor optical device component 11 and base optical device component 41 face each other in close proximity. *Id.* ¶ 66. In this position, pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76. In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Independent Claim 1

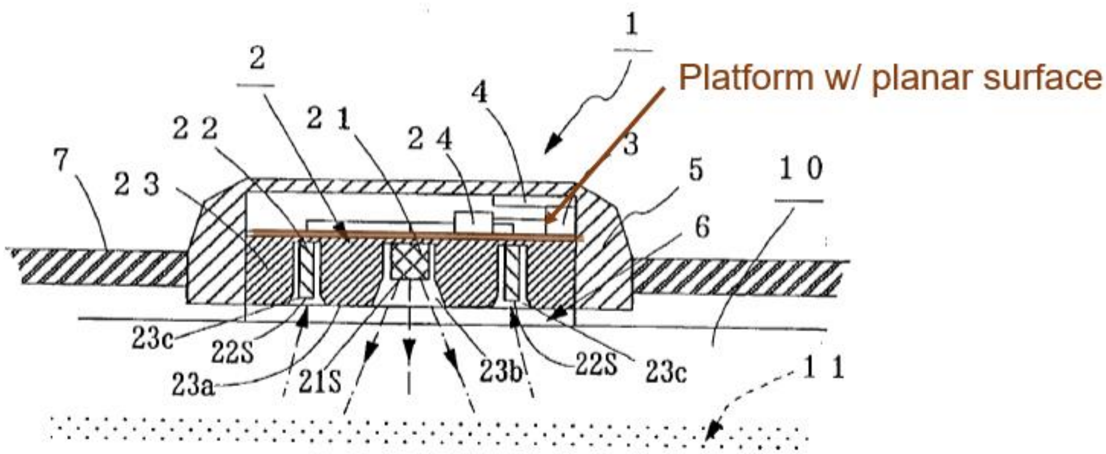
Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 12–16 (combination), 16–24 (claim 1).

i. "A noninvasive optical physiological sensing system comprising:"

Based on the final record, the cited evidence supports Petitioner's undisputed contention that Aizawa discloses a measurement device, i.e., a pulse sensor worn on a wearer's wrist. Pet. 16; *see, e.g.*, Ex. 1006 ¶ 2 ("[A] pulse wave sensor for detecting the pulse wave of a subject from light reflected from a red corpuscle in the artery of a wrist of the subject by irradiating the artery of the wrist with light.").

ii. [a] "a platform including a planar surface;"

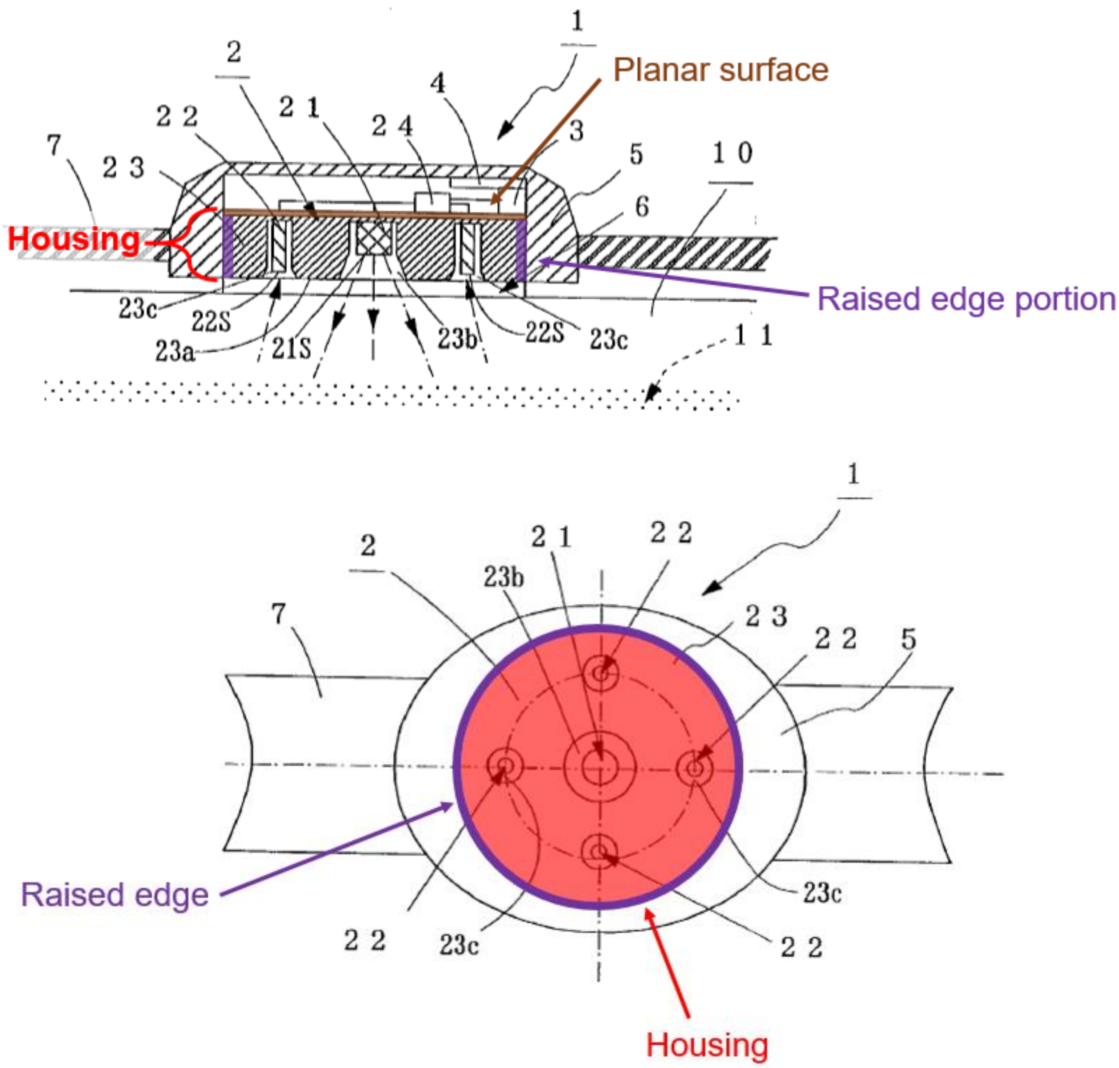
The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23 for storing light emitting diode 21 and photodetectors 22 and a platform including a planar surface on which holder 23 is placed. Pet. 17–18; *see, e.g.*, Ex. 1006 ¶ 23 ("LED 21 . . . for emitting light having a wavelength of a near infrared range"), Figs. 1(a)–(b). Petitioner provides the following annotated Figure 1(b) depicting the planar surface in brown.



Pet. 18. Annotated Figure 1(b) depicts Aizawa's sensor with the platform with a planar surface depicted in brown. *Id.* Petitioner contends that a person of ordinary skill in the art "would have understood that the various electronic components of Aizawa, including its detectors and emitter, are positioned within the holder 23 and further connected, through the identified platform that supports the holder 23, to a drive circuit 24 on the other side of the holder/platform." *Id.* (citing Ex. 1006 ¶ 23; Ex. 1003 ¶ 75).

iii. [b] "a housing including a raised edge portion extending from and enclosing at least a portion of the planar surface"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23, which includes a flat surface and a circular raised edge extending from the surface. Pet. 19; *see, e.g.*, Ex. 1006 ¶ 23 ("holder 23 for storing . . . light emitting diode 21 and the photodetectors 22"), Figs. 1(a)–(b) (depicting holder 23 surrounding each detector 22); Ex. 1003 ¶¶ 76–77. Petitioner provides annotated versions of Aizawa's Figures 1(a) and 1(b), which are reproduced below.



Pet. 19–20. Figures 1(a) and 1(b) depict side and top views of Aizawa's sensor with the housing depicted in red (holder 23), the raised edge depicted in purple, and the planar surface depicted in brown. *Id.*

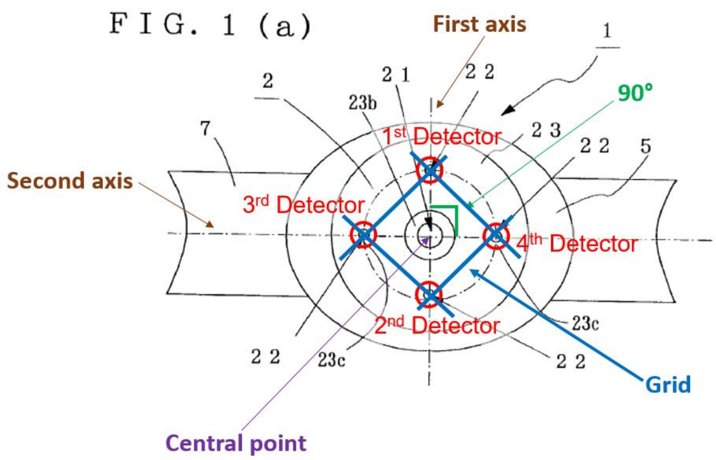
> *iv.* *[c] "at least four detectors arranged on the planar surface of the platform and within the housing, wherein the at least four detectors are arranged in a grid pattern such that a first detector and a second detector are arranged across from each other on opposite sides of a central point along a first axis, and a third detector and a fourth detector are arranged across from each other on opposite sides of the*

> *central point along a second axis which is perpendicular to the first axis; and"*

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses at least four detectors 22 that are disposed around light emitting diode 21 symmetrically in a perpendicular grid pattern around light emitting diode 21. Pet. 20–21; *see, e.g.*, Ex. 1006 ¶ 23 ("drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of the photodetectors 22"), Fig. 1(a) (depicting detectors 22 spaced apart around LED 21 in a symmetric grid pattern), Fig. 1(b) (depicting detectors 22 connected to a drive circuit 24 on the other side of the housing), ¶ 28 ("the amplified output is converted into a digital signal for the computation of a pulse rate"); Ex. 1003 ¶¶ 78–80.

Petitioner provides annotated Figure 1(a) of Aizawa showing how the four detectors "are arranged relative to a central point and first/second axes in the manner claimed, with the first/second axes being perpendicular to each other." Pet. 22.

FIG. 1 (a)



Pet. 22. Annotated Figure 1(a) depicts four detectors (in red) arranged in a grid pattern such that the first and second detector form a first axis that is

perpendicular to a second axis formed by the third and fourth detectors. *Id.* We find Petitioner's showing persuasive based on the final record.

v. [d] "the housing including a protruding light permeable cover."

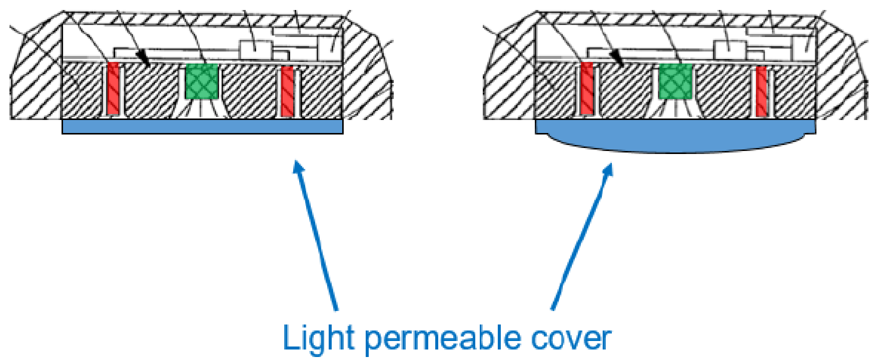
(1) Petitioner's Contentions

Petitioner contends that the cited evidence discloses this limitation. Pet. 12–16, 22–24. Specifically, Petitioner contends that Aizawa discloses a protruding cover in the form of an "acrylic transparent plate" mounted over at least a portion of the housing and to cover the at least four detectors. *Id.* at 22; Ex. 1006 ¶¶ 23, 34 ("[A]crylic transparent plate 6 is provided on the detection face 23a of the holder 23 to improve adhesion to the wrist 10."), Fig. 1(b) (depicting flat, transparent plate 6 between sensor 2 and wrist 10); Ex. 1003 ¶ 83 ("Because the light permeable cover of Aizawa . . . protrudes from the rest of the housing and is designed to be pressed into the skin when worn, it is protruding—and is thus a protruding light permeable cover.").

Petitioner further contends that Inokawa also teaches a protruding light permeable cover and provides motivation for incorporating such a cover into Aizawa. Pet. 13, 23. Specifically, Inokawa's lens 27 is positioned between its sensor and the wearer's skin, which increases the light gathering ability of the sensor. *Id.* at 13, 23; *see, e.g.*, Ex. 1008 ¶¶ 15 ("This lens makes it possible to increase the light-gathering ability of the LED as well as to protect the LED or PD."), 58 (disclosing "a single photodiode (S-side PD) 25 that receives the reflected light from these [LEDs], and an S-side lens 27"), Fig. 2.

In light of these teachings, Petitioner contends that a person of ordinary skill in the art "would have found it obvious to modify the flat

acrylic plate of Aizawa, as illustrated below, to further Aizawa's objective of enhancing light-collection efficiency," i.e., "by modifying the light permeable cover of Aizawa to include a convex protrusion that acts as a lens." Pet. 13, 23–24.



Pet. 14–15, 23–24; Ex. 1006 ¶¶ 13 (explaining that transparent plate 6 seeks to "improve adhesion" and "improve the detection efficiency of pulse waves"), 30 (same); Ex. 1008 ¶ 15; Ex. 1003 ¶¶ 82–87. Petitioner's annotated and modified Figures depict Aizawa's sensor including its flat transparent plate (left) and a modified version of Aizawa's sensor in which the plate includes a convex protrusion. Pet. 14, 24.

Petitioner contends this modification would have enjoyed a reasonable expectation of success because, for example, Inokawa teaches that the cover may be flat, like that of Aizawa, to reduce scratches, or in the form of a lens, as in Petitioner's proposed modification, to increase light gathering ability. *Id.* at 14–16; *see, e.g.*, Ex. 1008 ¶¶ 15 ("This lens makes it possible to increase the light-gathering ability."), 106 ("[B]ecause the surface of the covers 123, 131 is flat, the surface is less prone to scratches than when the lens protrudes."); Ex. 1003 ¶ 88.

(2) Patent Owner's Response

Patent Owner counters, arguing Aizawa alone "does not '[disclose] a protruding light permeable cover,' as required by claim 1." PO Resp. 15. According to Patent Owner, Petitioner has presented conflicting interpretations and assertions as to whether Aizawa's transparent plate (6) protrudes from holder (23). *Id.* (citing Pet. 9; Ex. 2004 ¶ 49). Patent Owner explains that "Petitioner's argument depends on arbitrarily changing Petitioner's identification of the 'housing' from (1) merely the holder (23) . . . to (2) the holder (23) and the transparent plate (6)." *Id.* at 14. However, Patent Owner argues that even if transparent plate (6) is part of the "housing," "there is no protrusion, as required by claim 1—the transparent plate (6) merely forms a flat face on the 'housing.'" *Id.* at 15.

Patent Owner does not dispute that Inokawa discloses such a protruding light permeable cover, but does argue that Petitioner has not shown that a person of ordinary skill in the art would have been motivated to combine Inokawa's convex lens with Aizawa's sensor. PO Resp. 15–35. According to Patent Owner, "neither Petitioner nor Dr. Kenny explains why a POSITA would have believed that Inokawa's convex lens, which concentrates light to a central detector, would enhance light collection in Aizawa's sensor (and the illustrated combination) with peripheral detectors." *Id.* at 14 (emphasis omitted). Rather, Patent Owner argues that "Petitioner, Dr. Kenny, and the '708 Patent all agree that a POSITA would have understood that Inokawa's protruding surface would direct incoming light towards the center of the sensor," which "undermines Petitioner's proposed combination because Aizawa's detectors are located at the periphery of the sensor." *Id.* at 19. Patent Owner explains that "a POSITA would have believed that Inokawa's protruding surface would direct light ***away*** from the

periphery-located detectors." *Id.* at 20 (citing Ex. 2004 ¶¶ 42–43, 50–59). As such, "a POSITA would have believed that a protruding surface would have undesirably ***decreased*** light-collection efficiency at Aizawa's peripheral detectors, reducing the measured optical signal." *Id.* (citing Ex. 1006 ¶¶ 26, 30; Ex. 2004 ¶ 60). Patent Owner further argues that the '708 patent illustrates how a protruding convex surface focuses light away from the periphery and towards the center. *Id.* at 23–24 (citing Ex. 1001, Fig. 14B).

Patent Owner contends that Dr. Kenny's testimony to the contrary is either contradictory or unsupported. Patent Owner writes that "Dr. Kenny admitted 'one of ordinary skill in the art would expect a diffuse light source encountering a convex lens of the sort that we're contemplating today, would lead to convergence of the light on the opposite side of the lens, in general' and that there would be 'a convergence of most of the light rays.'" *Id.* at 24 (citing Ex. 2007, 423:7–424:18) (emphases omitted). Comparing Dr. Kenny's testimony in the present case to prior testimony in IPR2020-01520, Patent Owner argues that Dr. Kenny's testimony is inconsistent or contradictory. *See id.* at 15–19, 22–26 (comparing prior testimony discussing how such a protruding surface like Inokawa's lens would cause incoming light to condense toward the center). Patent Owner's contention is that Dr. Kenny's "testimony falls far short of establishing a valid motivation to combine Inokawa with Aizawa, much less a reasonable expectation of success," with the "discussion of a reasonable expectation of success focus[ing] almost entirely on manufacturing." *Id.* at 31 (citing Ex. 2004 ¶ 75; Ex. 1003 ¶ 89). This possibility that a person of ordinary skill in the art could manufacture such a sensor, according to Patent Owner, falls short

of showing that such a person would reasonably expect success. *Id.* (citing Ex. 2004 ¶ 75; *In re Stepan Co.*, 868 F.3d 1342, 1347 (Fed. Cir. 2017)).

Patent Owner moreover asserts Petitioner errs in relying on Nishikawa as supporting the unpatentability of claim 1, because Nishikawa is "not identified as part of" the ground, which instead "includes only two references," Aizawa and Inokawa. PO Resp. 32 (citing Pet. 1–2, 15–16; Ex. 1003 ¶¶ 89); *id.* at 33–35 (citing 35 U.S.C. § 312(a)(3); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)). Patent Owner asserts Dr. Kenny "relies heavily" on Nishikawa, particularly "to inform the specific shape of the cover in his similar combination, which is found nowhere in Aizawa and Inokawa." *Id.* at 32, 34–35 (citing Pet. 23; Ex. 2004 ¶¶ 76–77; Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12).

Furthermore, in Patent Owner's view, "Petitioner's extensive reliance on Nishikawa makes no sense" because "Nishikawa's device is not a physiological sensor" but rather is "an encapsulated LED" that "directs ***outgoing*** light through the encapsulation material and thus focuses on the emission of light, not the detection of an optical signal." PO Resp. 34 (citing Ex. 1023, code (57), ¶¶ 3, 32, 35; Ex. 2004 ¶ 78). Patent Owner contrasts such disclosure with Aizawa and Inokawa, both of which "detect[] ***incoming*** light that passes through the cover and reaches the detectors," and which have a "drastically" smaller scale than Nishikawa's LEDs. *Id.* (citing Ex. 1008, Fig. 2; Ex. 2004 ¶ 78).

(3) Petitioner's Reply

In reply, Petitioner reiterates that "a POSITA would have been motivated to incorporate 'an Inokawa-like lens into the cover of Aizawa to

increase the light collection efficiency. . . .'" Pet. Reply 2–3 (quoting Pet. 12–14; Ex. 1003 ¶¶ 82–87). Petitioner counters Patent Owner's arguments by contending that Patent Owner has a "misinformed understanding of Inokawa's lens" and "lenses in general." *Id.* at 3 (citing PO Resp. 12). According to Petitioner, "a POSITA would understand that Inokawa's lens generally improves 'light concentration at pretty much all of the locations under the curvature of the lens,' as opposed to only at a single point at the center as asserted by Masimo." *Id.* (citing Ex. 2006, 164:8–16).

According to Petitioner, part of Patent Owner's misunderstanding may be due to Patent Owner ignoring the principle of reversibility. *Id.* at 4–14. For example, Petitioner contends that Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility," by which "a ray going from P to S will trace the same route as one from S to P." *Id.* at 4 (emphasis omitted) (citing, e.g., Ex. 1052,[7,8] 84, 87–92; Ex. 1049, 101, 106–111; Ex. 1047 ¶¶ 10–18). Petitioner contends that Dr. Madisetti was evasive when he was asked to apply the reversibility principle to the combination of Aizawa and Inokawa in this case. Pet. Reply 6 (citing Ex. 1034, 89:12–19). Petitioner further contends that, "based at least on the principle of reversibility," one of ordinary skill in the art "would have understood that both configurations of LEDs and detectors—*i.e.*, with the LED at the center as in Aizawa or with the detector at the center as in Inokawa—would

[7] Eugene Hecht, *Optics* (2nd ed. 1990).

[8] It is apparent that the page numbering identified by Petitioner for Exhibit 1052 refers to the document's native page numbering and not the page numbering of the exhibit appearing at the bottom, middle of each page. For clarity and consistency, in this Decision, we also use the same page numbering as Petitioner for Exhibit 1052.

similarly benefit from the enhanced light-gathering ability of an Inokawa-like lens." *Id.* at 9 (citing Ex. 1047 ¶ 22).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue in the user's wrist, to be received by detectors in either Aizawa's or Inokawa's pulse sensor, will be "scattered" and "diffuse" and, therefore, will approach the detectors "from various random directions and angles." Pet. Reply 9–10, 13 (annotating Inokawa's Fig. 2 to illustrate the cause and nature of the back-scattering); Ex. 1047 ¶¶ 25–26, 31. This scattered and diffuse light, according to Petitioner, means that Inokawa's "lens cannot focus all incoming light toward the sensor's center," as Patent Owner would have it. Pet. Reply 9 (citing Ex. 1047 ¶ 23; Ex. 2006, 163:12–164:2). Petitioner asserts this is due to Snell's law, and provides several illustrations to illustrate why. *Id.* at 9–15 (citing, e.g., Ex. 1047 ¶¶ 23–34).

Due to the random nature of this scattered light, Petitioner explains that one of ordinary skill in the art would have understood that a convex cover "provides a slight refracting effect, such that light rays that may have missed the detection area are instead directed toward that area." Pet. Reply 10 (citing Ex. 1047 ¶¶ 25–26). Petitioner applies this understanding to Aizawa, and contends that using a lens with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source. *Id.* (citing Ex. 1051, 86, 90).

Moreover, Petitioner dismisses the applicability of Figure 14B of the '708 patent as illustrating the operation of a *transmittance*-type of sensor that measures the attenuation of collimated light transmitted through the

user's body tissue, rather than the *reflectance*-type sensor of Aizawa. *Id.* at 11–13 (citing, e.g., Ex. 1001, 35:65–67; Ex. 1047 ¶¶ 27–31).

Petitioner further maintains that contrary to Patent Owner's argument, Petitioner's illustrations of the light-focusing properties of a convex lens discussed in the Petition filed in IPR2020-01520 (Ex. 2019, 39) and relied upon by Dr. Kenny (Ex. 2020, 119–120) do not demonstrate "that a convex lens directs all light to the center." Pet. Reply 15 (citing PO Resp. 15–17). Petitioner contends these illustrations, instead, "are merely simplified diagrams included to illustrate . . . one example scenario (based on just one ray and one corpuscle) where a light permeable cover can 'reduce a mean path length of light traveling to the at least four detectors'" as recited in claim 12 of the patent challenged in that proceeding. *Id.* (citing, e.g., Ex. 1047 ¶ 34).

(4) Patent Owner's Sur-reply

Patent Owner asserts that Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *See, e.g.*, Sur-reply 1 ("new optics theories" and "new arguments"), 2, 6, 7, 9, 10, 12, 13.

Patent Owner also contends that Petitioner mischaracterizes Patent Owner's position, which is not that Inokawa's lens with a convex protrusion "would direct '***all***' light 'only at a ***single point*** at the center'" of the sensor. *Id.* at 2 & n.2 (quoting Pet. Reply 3; citing, e.g., Ex. 2027, 63:7–64:6, 94:20–96:1, 96:18–97:7). Patent Owner's position, rather, is that Inokawa's lens condenses more light (not necessarily all light) "***towards the center*** of the sensor" as compared to a flat surface. *Id.* at 2 (quoting PO Resp. 19; citing, e.g., Ex. 2004 ¶¶ 34, 43, 51, 53–54, 57, 67).

Patent Owner moreover asserts "[t]here can be no legitimate dispute that a convex surface directs light centrally (and away from the periphery)." Sur-reply 3–6 (citing PO Resp. 15–18; Ex. 2006, 86:19–87:6, 164:8–16, 170:22–171:5, 202:11–204:20; Ex. 2020 ¶¶ 119, 200; Ex. 2027, 181:9–182:5). Patent Owner contends that Petitioner's argument "that Inokawa would improve light-gathering at all locations, ***regardless*** of the location of the LEDs and detectors" is belied by Dr. Kenny's testimony that "Inokawa's benefit would ***not*** be clear if Inokawa's LEDs and detectors were moved" and "confirmed that a convex surface would direct light toward the center of the underlying sensor." *Id.* at 6 (citing Pet. Reply 3–4; Ex. 2006, 86:19–87:6, 202:11–204:20).

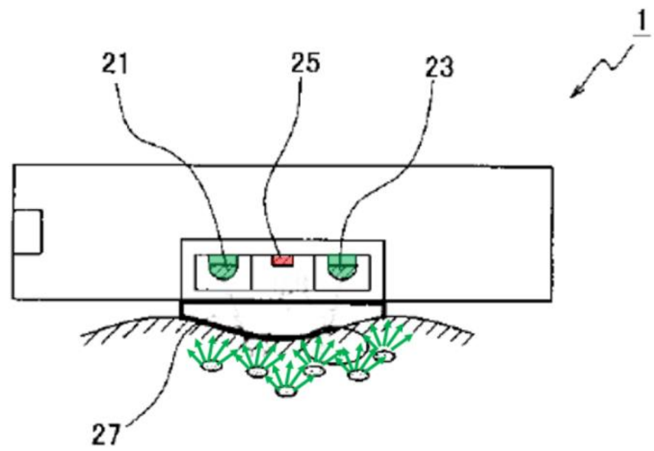
Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes ideal conditions that are not present when tissue scatters and absorbs light." Sur-reply 6–8 (citing Ex. 2027, 17:12–19:2, 29:11–30:7, 31:8–32:3, 38:17–42:6, 207:9–209:21, 210:8–6). The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether a convex surface—***as compared with a flat surface***—would collect and focus additional light on Aizawa's peripherally located detectors." *Id.* at 8–9 (citing Ex. 2027, 212:3–14).

Patent Owner also argues that Petitioner's position that a convex cover will provide a "***slight*** refracting effect," "directly undermines Petitioner's provided ***motivation*** to combine," i.e., to enhance light collection efficiency. *Id.* at 10–11.

(5) Analysis

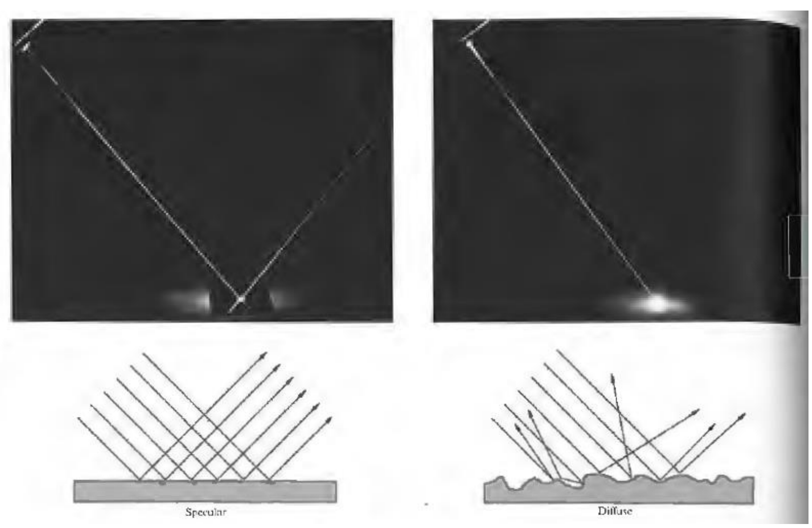
Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's view that it would have been obvious to modify Aizawa's cover 6 to include a convex lens or protrusion like that taught in Inokawa, in order to increase the amount of backscattered light that will be received by Aizawa's four peripheral detectors 22, as compared with Aizawa's existing flat cover.

Aizawa's and Inokawa's pulse sensors both gather data by emitting light into the user's wrist tissue, and collecting light that reflects back to the sensor from the user's tissue. *See, e.g.*, Ex. 1006, Figs. 1(b), 2 (sensor 2 has emitter 21 and four detectors 22, all facing a user's wrist 10); Ex. 1008, Figs. 1, 2 (sensor 1 has two emitters 21, 23 and one detector (photodiode 25), all facing the user's wrist when held in place by wristband 5). Dr. Kenny testifies, and Patent Owner agrees, that the reflection of this light by the user's wrist tissue randomizes the propagation direction of the reflected light rays. *See* Ex. 1003 ¶¶ 82–87; Ex. 1047 ¶¶ 14–15; Ex. 2020 ¶ 128; Sur-reply 7 ("Even Petitioner admits that tissue randomly scatters and absorbs light rays."). This reflection principle is illustrated by Dr. Kenny's annotations to Inokawa's Figure 2 reproduced below:



Here, Dr. Kenny has modified Inokawa's Figure 2 (1) by removing two black arrows, (2) by coloring Inokawa's light detector in red and Inokawa's two light emitters in green, and (3) by adding several green arrows to illustrate the various directions that light rays may be directed after impinging on and reflecting off different tissues in the user's wrist. Ex. 1047 ¶ 32.

This randomized direction of reflected light rays results in backscattered light that is diffuse, rather than collimated, in nature. Figure 4.12 of Exhibit 1052 illustrates the difference between diffuse and collimated light, and is reproduced below:

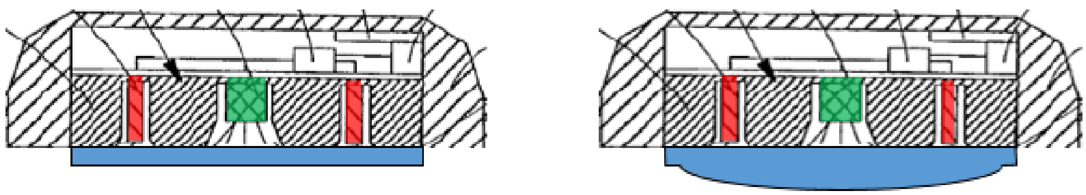


This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1052, 87–88. The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* By contrast, the rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*

This diffuse nature of the light reflected from the user's wrist tissue, which both Aizawa and Inokawa aim to collect to generate pulse data, suggests that a lens might be useful to increase the amount of collected light and thereby increase the reliability of the pulse data generated using the collected light. Indeed, that is taught by Inokawa. Inokawa describes using its lens 27 to "increase the light-gathering ability" of Inokawa's light photodiode or detector 25.[9] Ex. 1008 ¶¶ 15, 58. Furthermore, there is also no dispute that Inokawa's lens 27 is understood to be shaped as a convex protrusion. *See, e.g.*, Ex. 1003 ¶¶ 84–85 (characterizing Inokawa as teaching a "convex protrusion that acts as a lens"); PO Resp. 1 (describing Inokawa as teaching a "convex lens"). Thus, Inokawa demonstrates that it was known in the art to use a lens comprising a protrusion to focus diffuse light reflected from body tissue on to the light detecting elements of a wrist-worn pulse sensor, and to increase the light gathered by the sensor thereby improving the device's calculation of the user's pulse.

[9] Although Inokawa refers to the "LED" such as emitters 21, 23 in that regard (*id.* ¶ 15), rather than photodiode 25, it is undisputed that photodiode 25 is the only component of Inokawa's sensor 1 that gathers light.

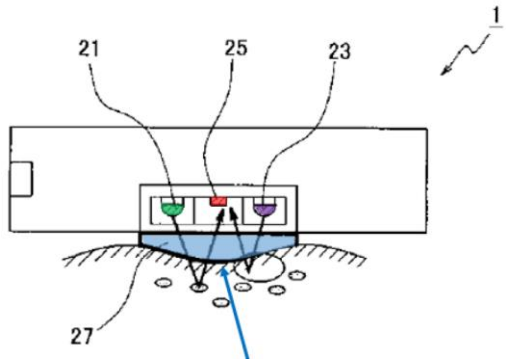
A preponderance of the evidence supports Petitioner's view that it would have been obvious for a person of ordinary skill in the art to apply Inokawa's lens technology to Aizawa's wrist-worn pulse sensor, to similarly improve its light collection as compared to Aizawa's existing flat cover. That is illustrated by the following annotated figures provided by Dr. Kenny:

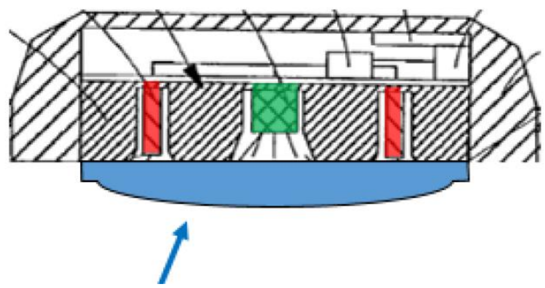


The illustration at left modifies Aizawa's Figure 1(b) to color Aizawa's emitter in green, its detectors in red, and Aizawa's existing flat cover in blue; the illustration on the right includes Aizawa's Figure 1(b) with the same color coding, but wherein the flat cover is modified to incorporate a convex protrusion that covers Aizawa's peripheral light detectors and central light emitter. *See* Ex. 1003 ¶ 87. We are persuaded by Dr. Kenny's testimony that Snell's law indicates that "light rays that may have otherwise missed the detection area are instead directed toward that area as they pass through the interface provided by the cover," and is especially true "in configurations like Aizawa's in which light detectors are arranged symmetrically about a central light source, so as to enable backscattered light to be detected within a circular active detection area surrounding that source." Ex. 1047 ¶ 26; *see also id.* ¶¶ 23–26.

Patent Owner correctly notes that Inokawa's single detector 25 is located in the central portion of Inokawa's sensor 1, whereas Aizawa's four detectors 22 are located towards the periphery of Aizawa's sensor 2. *Compare* Ex. 1008, Fig. 2, *with* Ex. 1006, Figs. 1(a)–1(b). Nevertheless, Petitioner's proposed modification of Aizawa takes that arrangement into

account, as can be seen by the following comparison between Inokawa's sensor and Petitioner's proposed modification of Aizawa's sensor:





The illustration at left annotates Inokawa's Figure 2 to identify the central detector in red and the lens in blue (*see* Ex. 1003 ¶ 85), and the illustration at right annotates Petitioner's proposed modification of Aizawa to illustrate the peripheral detectors in red and the lens in blue (*see id.* ¶ 87). As can be seen, the lenses are not identical. In Inokawa, the lens's curvature is most pronounced at the center of the lens near the central detector, and in the proposed modification to Aizawa, the lens's curvature is most pronounced at the edges of the lens near the peripheral detectors. Thus, Dr. Kenny's proposed modification of Aizawa takes Inokawa's general teaching of using a convex protrusion lens to increase the amount of incoming light directed to a light detector, and applies it to the four light detectors of Aizawa. *See, e.g.*, Ex. 1003 ¶ 87 ("[A] POSITA would have found it obvious to combine the teachings of Aizawa and Inokawa such that the flat cover (left) of Aizawa is modified to include a lens/protrusion (right) as per Inokawa in order to 'increase the light-gathering ability,'" and "allow more light to be gathered and refracted toward the light receiving cavities of Aizawa, thereby further increasing the light-gathering ability of Aizawa beyond what is achieved through the tapered cavities."); *id.* ¶¶ 82–89; Ex. 1047 ¶¶ 7–34.

We are cognizant of Patent Owner's contention that Petitioner's ground "improperly" relies upon a reference, Nishikawa, that was not identified as a part of the ground of unpatentability. PO Resp. 32–33. As Patent Owner observes, Dr. Kenny characterizes his testimony as being "***inspired*** by" or "motivated" in part based on Nishikawa's disclosure when it comes to the shape of a convex lens. *See, e.g.*, PO Resp. 32–33 (citing, e.g., Ex. 2007, 364:2–13; Ex. 2008, 73:8–12) (emphasis omitted). We, however, disagree with Patent Owner that any impropriety arises from Dr. Kenny's contemplation of the teachings of Nishikawa in connection with the shape of a lens for a physiological sensor. The nature of Petitioner's and Dr. Kenny's consideration of Nishikawa is explained in cited portions of Dr. Kenny's declaration, even if Nishikawa is not listed as a third reference in the identification of the ground. *See* Ex. 1003 ¶ 89 ("[M]any prior art references of this period, such as Nishikawa (shown below) demonstrate exactly how such a lens [as taught by Inokawa] may be incorporated into a molded cover."); Pet. 15–16. Indeed, it follows readily from the Petition that a skilled artisan would have appreciated that Nishikawa's teachings provide insight as to how "the transparent acrylic material used to make Aizawa's plate can be readily formed into a lens [structure] as in Inokawa." Pet. 15. Nishikawa describes how its "lens unit 50" can be a transparent resin formed in the shape illustrated in Figure 6 by injection molding. Ex. 1023 ¶¶ 22, 32, 35. Dr. Kenny also explains that Nishikawa's lens shape design "is intended to provide curvature in the lens where it can do the most good and otherwise try to avoid excess use of material in order to create curvature in locations where it wouldn't do any good." Ex. 2006, 179:21–180:13.

Moreover, we observe that a rejection based on obviousness "require[s] an analysis that reads the prior art in context, taking account of 'demands known to the design community,' 'the background knowledge possessed by a person having ordinary skill in the art,' and 'the inferences and creative steps that a person of ordinary skill in the art would employ.'" *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (quoting *KSR*, 550 U.S. at 418). Furthermore, record evidence can be useful to "demonstrate the knowledge and perspective of one of ordinary skill in the art." *Id.*; *see also Ariosa Diagnostics v. Verinata Health Inc.*, 805 F.3d 1359, 1365 (Fed. Cir. 2015) ("Art can legitimately serve to document the knowledge that skilled artisans would bring to bear in reading the prior art identified as producing obviousness.").

As noted above, Dr. Kenny makes clear that his view as to obviousness of the claims of the '708 patent was "inspired by" or "motivated" in part by Nishikawa's teachings as to shapes generally known to those in the art of manufacturing a lens. *See, e.g.*, Ex. 2007, 364:2–13; Ex. 2008, 73:12–21. We conclude that the record establishes that Nishikawa's teachings are representative of background knowledge of one of ordinary skill in the art and provide context and perspective of a skilled artisan as to the type of shapes available for a convex protruding surface, such as that disclosed in Inokawa. That Dr. Kenny considered record evidence cited in the Petition as informing his view of what a skilled artisan would understand as to known types of lens shapes does not establish, in our view, any impropriety as part of that ground.

Patent Owner additionally asserts, and Dr. Madisetti testifies, that Petitioner's combination of Aizawa and Inokawa is "problematic" because it overlooks the "small" size of Aizawa's detectors 22 and the openings or

cavities 23c in which they are housed. *See* PO Resp. 21–22 (citing Ex. 1006, Fig. 1(a); Ex. 2004 ¶ 65). Patent Owner, however, does not articulate what significance the size of Aizawa's detector components have in the obviousness evaluation based on the teachings of the prior art.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new arguments and evidence that should have been first presented in the Petition. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa's device. *See, e.g.*, Pet. 12–16. Patent Owner, in its Response, then challenged that contention with several arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleged. *See, e.g.*, PO Resp. 15–35. In its Reply, Petitioner provided arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019),[10] 73 ("A party also may submit rebuttal evidence in support of its reply."). The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 12–16, *with* Pet. Reply 2–13.

Patent Owner finally argues that a conclusion of obviousness "strains credibility" because the level of ordinary skill in the art (*see supra* Section II.B) does not require specific education or experience with optics or optical physiological monitors. *See, e.g.*, PO Resp. 30. We disagree. Concerning motivation, an ordinarily skilled artisan would have readily appreciated from the record at hand that: (1) Aizawa's detector 1 operates

---

[10] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

by gathering light data with its photodetectors 22; (2) a lens was known to focus the light on photodetectors; and (3) optical lenses may be formed by providing a convex protrusion in the lens to focus light. Indeed, Inokawa discloses such utility, function, and structure as a part of its convex lens. *See, e.g.*, Ex. 1008 ¶¶ 15, 58, Fig. 2. We are persuaded that a person of ordinary skill in the art would have understood these general concepts of optics.

Concerning reasonable expectation of success, we rely on Dr. Kenny's testimony that a person of ordinary skill in the art would have understood that "by positioning a lens above the optical components of Aizawa . . . the modified cover will allow more light to be gathered and refracted toward the light receiving cavities of Aizawa, thereby further increasing the light-gathering ability of Aizawa beyond what is achieved through the tapered cavities," and "would have found it obvious to combine the teachings of Aizawa and Inokawa such that the flat cover (left) of Aizawa is modified to include a lens/protrusion (right) as per Inokawa in order to 'increase the light-gathering ability.'" *See, e.g.*, Ex. 1003 ¶ 87; Ex. 2006, 179:21–180:13, 202:11–20.

Thus, we conclude that one of ordinary skill in the art would have had adequate reason to replace Aizawa's flat cover 6 with a cover comprising a convex protrusion, to improve light detection efficiency, and would have had a reasonable expectation of success in doing so.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

4. Independent Claim 19

Independent claim 19 consists of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:36–50, *with id.* at 45:53–46:11 (reciting a "housing including a raised wall protruding"). In asserting that claim 19 also would have been obvious over the combined teachings of Aizawa and Inokawa, Petitioner refers to substantially the same contentions presented as to claim 1. *See* Pet. 35–38; Ex. 1003 ¶¶ 110–115.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 11–35.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 19 would have been obvious over the cited combination of references. *See supra* II.D.3.i–v; Ex. 1003 ¶¶ 110–115.

5. Dependent Claims 2–9, 11, 13–15, 20–22, and 24–27

Petitioner presents undisputed contentions that claims 2–9, 11, 13–15, 20–22, and 24–27, which depend directly or indirectly from independent claim 1 or 19, are unpatentable over the combined teachings of Aizawa and Inokawa, and provides arguments explaining how the references teach the limitations of these claims. Pet. 24–35, 38–40; Ex. 1003 ¶¶ 90–109, 116–122.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 35 ("The Petition fails to establish that independent claims 1 and 19 would have been obvious in view of [the first ground]'s cited references

and thus fails to establish obviousness as to any of the challenged dependent claims.") (citing Ex. 2004 ¶ 79).

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–9, 11, 13–15, 20–22, and 24–27 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

E. Obviousness over Aizawa, Inokawa, and Ohsaki

Petitioner argues claims 1–9, 11, 13–15, 19–22, and 24–27 of the '708 patent would have been obvious over Aizawa, Inokawa, and Ohsaki. Pet. 2, 40–43. Patent Owner opposes. PO Resp. 35–39. We conclude a preponderance of the evidence supports Petitioner's assertions as to these challenged claims. We begin our analysis with a brief summary of Ohsaki, then we address the parties' contentions.

1. Ohsaki Disclosure

Ohsaki discloses a pulse wave sensor attached to the back side of the user's wrist. Ex. 1014, codes (54), (57). Figures 1 and 2 are reproduced below:

FIG. 1

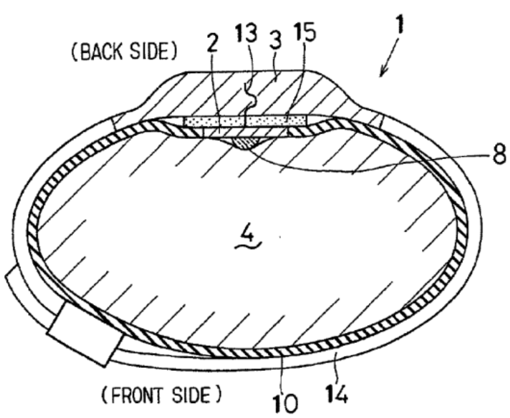


FIG. 2

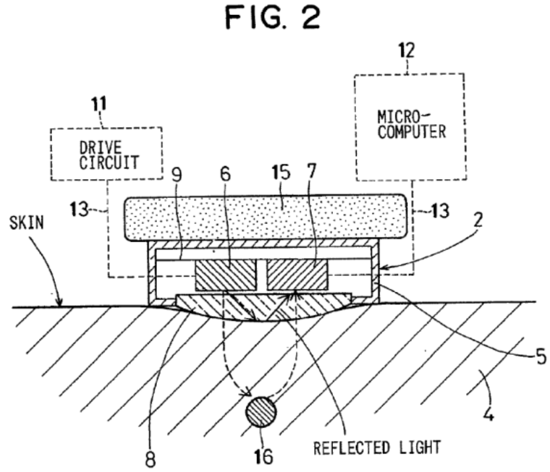


Figure 1 is a cross-sectional view of pulse wave sensor 1 attached on a user's wrist 4. *Id.* ¶¶ 12, 16, 18. Figure 2 is a schematic diagram of detecting element 2 of sensor 1 on wrist 4, and associated electronics. *Id.* ¶¶ 13, 17.

Figure 1 illustrates how detecting element 2 is attached to the back side of the wrist. In this context, the wrist's "back" side is the side opposite to the user's palm, and the wrist's "front" side is the palm side of the hand. *See, e.g.*, *id.* ¶¶ 5–6, 16.

Detecting element 2 comprises a light emitter (LED 6) and a light detector (photodetector 7) for optically interrogating the user's wrist 4 tissue to detect a pulse wave of the user. *See id.* ¶¶ 3, 7–8, 16, 20, 22. Translucent board 8 of element 2 has "a convex surface . . . in intimate contact with the surface of the user's skin," and "[t]hereby it is prevented that the detecting element 2 slips off the detecting position of the user's wrist 4." *Id.* ¶¶ 9, 17–18, 25.

Figures 3A–3B provide test data comparing the performance of a pulse wave sensor depending on whether it is mounted to the back side or the front side of the user's wrist. *See id.* at Figs. 3A–3B, ¶¶ 14, 23–24. Figures 4A–4B provide test data comparing the performance of a pulse wave sensor depending on whether translucent board 8 is convex (as shown in Figures 1 and 2) or flat. *See id.* at Figs. 4A–4B, ¶¶ 15, 25.

2. Claim 1

Petitioner provides arguments and evidence, including testimony from Dr. Kenny, in support of Petitioner's contention that claim 1 is unpatentable as having been obvious over Aizawa, Inokawa, and Ohsaki. Pet. 40–43; Ex. 1003 ¶¶ 64–65, 123–127. Patent Owner provides arguments and

evidence in opposition, including testimony from Dr. Madisetti. PO Resp. 35–39; Ex. 2004 ¶¶ 80–86.

This ground relies on the same prior art as in the prior ground, then adds Ohsaki as providing a further motivation for modifying Aizawa's flat plate 6 to have a convex protrusion. *See* Pet. 40–43; Ex. 1003 ¶¶ 123–127. Petitioner asserts "Ohsaki teaches that adding a convex surface to the light permeable cover (*i.e.*, [Ohsaki's] translucent board 8) can help prevent the device from slipping on the tissue when compared to a flat cover" such as Aizawa's plate 6. Pet. 42–43 (citing Ex. 1014 ¶ 25); Ex. 1003 ¶ 125. Petitioner asserts that Aizawa, similarly to Ohsaki, "seeks to prevent slippage between the device and the user's wrist—and pursues this objective by pressing its . . . [plate 6] and trying to improve 'adhesion between the wrist 10 and the pulse rate detector 11.'" Pet. 43 (citing Ex. 1006 ¶¶ 26, 30); Ex. 1003 ¶ 125. Dr. Kenny testifies a POSITA "would have recognized that Ohsaki's addition of a convex protrusion to its light permeable cover could be similarly implemented in Aizawa's device to help achieve the two references' shared goal of minimizing slippage," which "would have allowed Aizawa's sensor device to remain better adhered to the skin and thereby increase its light-collecting efficiency." Ex. 1003 ¶¶ 126, 142 (citing Ex. 1006 ¶¶ 26, 30; Ex. 1014 ¶ 25); Pet. 42–43.

Patent Owner argues in opposition that the Petition is fatally deficient because it is "unclear as to whether a POSITA would have incorporated Inokawa's lens or Ohsaki's translucent board" in Aizawa. PO Resp. 36; Ex. 2004 ¶ 80. We disagree. The first ground relies on Inokawa as providing a first motivation for adding a protrusion to Aizawa's flat cover: to direct more light to Aizawa's detectors 22. *See supra* Section II.D.3.v. This ground relies additionally on Ohsaki as providing a second, and

independent, motivation for adding a protrusion to Aizawa's flat cover: to reduce slippage between Aizawa's device and the user's wrist. *See* Pet. 42–43. Neither ground seeks to bodily incorporate Inokawa's lens or Ohsaki's translucent board into Aizawa's device, and this is not required for obviousness. *See In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

Patent Owner next contends that Patent Owner's various arguments opposing first ground also apply to this ground. *See* PO Resp. 35–36; Ex. 2004 ¶ 82. For the reasons provided in Section II.D.3 above, Patent Owner's arguments opposing the first ground based on Aizawa and Inokawa are unavailing.

Patent Owner further asserts "a POSITA would have understood that Ohsaki's board would not prevent slippage with Aizawa's sensor." PO Resp. 37 (section heading modified). According to Patent Owner, Ohsaki indicates "its protruding surface must have ***longitudinal directionality***" such that "one must orient its longitudinal convex surface with the longitudinal direction of the user's arm." PO Resp. 37 (citing Ex. 1014 ¶ 19); Ex. 2004 ¶ 83. Patent Owner argues Aizawa's detector 1, by contrast, uses a circular arrangement of four detectors 22 around one emitter 21, and "Aizawa specifically ***distinguishes*** its sensor from linear sensors such as Ohsaki's." PO Resp. 37 (citing Ex. 1006, code (57), ¶¶ 9, 27, 36; Ex. 1014 ¶ 19; Ex. 2008, 165:20–166:5); Ex. 2004 ¶ 84. Patent Owner concludes a "POSITA would not have believed Ohsaki's longitudinal protruding surface would benefit Aizawa's sensor" due to this difference. PO Resp. 38; Ex. 2004 ¶ 85.

Patent Owner moreover argues Ohsaki's "protruding surface only prevents slipping on the backhand side (i.e., watch-side) of the user's wrist," and "Ohsaki's sensor has 'a tendency to slip off' if it is on the palm side of

the user's wrist." PO Resp. 37 (citing Ex. 1014 ¶¶ 23–24, Figs. 3A–3B); Ex. 2004 ¶ 83. Patent Owner asserts Aizawa's detector 1, by contrast, is held against the front side of the user's wrist to be close to the artery there, and "Aizawa reports that on the ***palm side*** of the wrist, a ***flat surface*** improves adhesion." PO Resp. 37–38 (citing Ex. 1006, Figs. 2, 3, code (57), ¶¶ 2, 9, 13, 26–28, 30, 34, 36); Sur-reply 14–15 (similarly citing Ex. 1006); Ex. 2004 ¶¶ 84–85. Patent Owner cites evidence demonstrating that these arteries are on the front side of the wrist. PO Resp. 38 (citing Ex. 2010, 44, 71 (Plates 429 and 456)); Ex. 2004 ¶ 85. Patent Owner concludes a POSITA would not have believed Ohsaki's convex surface would benefit Aizawa's device based on this difference in device location on the user's wrist. PO Resp. 38; Ex. 2004 ¶ 85.

Petitioner replies that, despite the differences between Aizawa and Ohsaki identified by Patent Owner, a POSITA would nonetheless have understood from Ohsaki that "a convex surface . . . can help prevent the device from slipping on the tissue of the wearer compared to using a flat cover without such protrusion." Pet. Reply 15–16 (quoting Ex. 1003 ¶¶ 125–126); Ex. 1047 ¶ 35. According to Petitioner, Ohsaki contrasts between "flat" and "convex" detecting surfaces, and explains the "detected pulse wave is adversely affected by the movement of the user's wrist" with a flat surface but not a convex surface. Pet. Reply 16 (citing Ex. 1014, Figs. 1, 2, 4A–4B, ¶¶ 15, 17, 25); Ex. 1047 ¶ 37. Petitioner asserts "Ohsaki was relied upon not for its exact cover configuration" as Patent Owner suggests, but instead "for the rather obvious concept that a convex surface protruding into a user's skin will prevent slippage." Pet. Reply 18; Ex. 1047 ¶ 37 ("[A]dding a convex surface to Aizawa's flat plate will serve to ***improve*** its tendency to not slip off, not take away from it, since it is well understood

that physically extending into the tissue and displacing the tissue with a protrusion provides an additional adhesive effect.”).

Patent Owner replies “Ohsaki demonstrates that a convex surface alone does ***not*** prevent slipping because Ohsaki’s shape is designed to fit within the underlying bone structure of the wrist and forearm on the backhand side.” Sur-reply 16 (citing Ex. 1014, Figs. 3A–3B, ¶¶ 6, 19, 23–24). Patent Owner asserts “Ohsaki explains that a convex surface on the palm side has a tendency to slip, notwithstanding any alleged ‘physical[] digging.’” *Id.* at 17 (alteration in original). Ohsaki also teaches, according to Patent Owner, “that one should avoid too much pressure because otherwise the user ‘feels uncomfortable,’ which results in movement and a tendency to slip.” *Id.* (citing Ex. 1014 ¶¶ 6, 18, 24).

Upon review of the foregoing arguments and evidence, we conclude a preponderance of the evidence supports Petitioner’s contention that a person of ordinary skill in the art would have been motivated to modify Aizawa’s plate 6 to include a convex protrusion, in order to help prevent slippage of Aizawa’s detector 1 on the user’s wrist, based on Ohsaki.

A person of ordinary skill in the art would have understood from Ohsaki that forming a convex protrusion on the face of an optically-based pulse sensor where it is pressed against the user’s wrist to gather optical data will beneficially prevent slippage of the sensor during operation. Ohsaki states: “The detecting element 2 is arranged on the user’s wrist 4 so that *the convex surface* of the translucent board 8 *is in intimate contact with the surface of the user’s skin. Thereby it is prevented that the detecting element 2 slips* off the detecting position of the user’s wrist 4.” Ex. 1014 ¶ 25 (emphases added). A POSITA would understand from this disclosure that forming a convex protrusion on the tissue-contacting face of a

wrist-worn, optically-based pulse sensor will resist movement of the sensor on the user's wrist during use. *See* Ex. 1003 ¶¶ 141–142; Ex. 1047 ¶ 52. A POSITA would also understand this resistance to be a beneficial result, because it will improve the pulse sensor's ability to emit light into and detect light reflected from the user's wrist, to generate a pulse signal. *See* Ex. 1006 ¶¶ 26, 30, 34; Ex. 1014 ¶¶ 23, 25, 27; Ex. 1003 ¶¶ 125–126; Ex. 1047 ¶ 37.

Indeed, Ohsaki expressly compares the performance of a wrist-worn pulse wave sensor depending on whether translucent board 8 is convex or flat, and concludes the former results in improved performance over the latter, especially when the user is moving. *See* Ex. 1014, Figs. 4A–4B, ¶¶ 15, 25 (stating that with "a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist 4," and with "a convex surface like the present embodiment, the variation of the amount of the reflected light" collected by the sensor "is suppressed"). Ohsaki also states that, with a convex protrusion, it is "prevented that noise such as disturbance light from the outside penetrates the translucent board 8." *Id.* ¶ 25.

Patent Owner and Dr. Madisetti attempt to limit the foregoing disclosures of Ohsaki to its particular context—a sensor having one emitter 6 disposed next to one detector 7 to define a "longitudinal" sensing direction between them, and being attached to the back side rather than the front side of the user's wrist. *See* Ex. 2004 ¶¶ 83–85. We are not persuaded. For example, Ohsaki's disclosure does not support Dr. Madisetti's conclusion that it is *only* in this particular context that a convex protrusion will help prevent slippage. *See* Ex. 1014 ¶ 19 (discussing the longitudinal direction orientation of Ohsaki's sensor); *id.* at Figs. 3A–3B, ¶¶ 16, 23–24 (discussing attaching Ohsaki's sensor to the back side of the wrist). Figures 3A–3B

compare the performance of detecting element 2, including its translucent board 8 having a convex protrusion, and show better performance when it is attached to the back side of the wrist versus the front side of the wrist, when the user is in motion. *See* Ex. 1014 ¶¶ 17 (Fig. 2), 23–24 (Figs. 3A–3B). Because the tested device incorporates a convex protrusion in both instances, Figures 3A–3B do not support Dr. Madisetti's conclusion that "Ohsaki teaches that a protruding surface on the palm side of the wrist would not prevent slipping" — particularly in comparison to a flat surface such as Aizawa's. Ex. 2004 ¶ 85.

We credit, instead, Dr. Kenny's testimony that a person of ordinary skill in the art would have understood from Ohsaki that a convex protrusion will help prevent slippage, even in the context of Aizawa's arrangement of four detectors surrounding a central emitter (or emitters, when modified per Inokawa) attached on the front side of the user's wrist. *See* Ex. 1047 ¶ 37. This is because, even in Aizawa's arrangement, the convex protrusion will "physically extend[] into the tissue and displac[e] the tissue," as is illustrated for example in Ohsaki's Figures 1 and 2, where translucent board 8 physically extends into and displaces the tissue of wrist 4. *Id.*

Dr. Madisetti also testifies that "Aizawa reports that on the palm side of the wrist, a flat surface improves adhesion," so "a POSITA would have believed that adding Ohsaki's protruding surface would have disrupted the improved adhesion properties reported for Aizawa's flat plate." Ex. 2004 ¶ 85 (citing Ex. 1006, Figs. 3A–3B, ¶¶ 13, 26, 28, 30, 34; Ex. 1014, Figs. 3A–3B, ¶¶ 23–24). We disagree with this reading of Aizawa. It is true that Aizawa's plate 6 is illustrated as having a flat surface (Ex. 1006, Fig. 1(b)), and that Aizawa states the plate "improve[s] adhesion" (*id.* ¶ 13). Aizawa also states: "the above belt 7 is fastened such that the acrylic

transparent plate 6 becomes close to the artery 11 of the wrist 10," and "[t]hereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶ 26. These disclosures, however, indicate the improved adhesion is provided by the acrylic material of plate 6, not the flat surface of plate 6 as Dr. Madisetti would have it. *See also id.* ¶¶ 30, 34 ("Since the acrylic transparent plate 6 is provided . . . adhesion between the pulse rate detector 1 and the wrist 10 can be improved . . . ."). Thus, there is no teaching away from using a convex surface to improve the adhesion of Aizawa's detector to the user's wrist. *See, e.g.*, Ex. 1003 ¶ 126; Ex. 1047 ¶ 37.

Finally, we acknowledge that both Aizawa and Ohsaki express a concern about exerting too much pressure against the front side of the user's wrist, because this would make the user uncomfortable. *See, e.g.*, Ex. 1006 ¶¶ 6, 26, 31; Ex. 1014 ¶¶ 6, 18, 24. Thus, a person of ordinary skill in the art would understand that there are operational limits on how large the protrusion can be made in Aizawa. Nonetheless, claim 1 does not place any limitations on the size of the protrusion, and as discussed above a protrusion would improve the ability to avoid slippage of Aizawa's detector 1 when worn on the front side of a user's wrist. Therefore, it would have been obvious to add a protrusion to Aizawa's detector 1 for that purpose, and optimize the size of the protrusion to avoid user discomfort.

Based on the foregoing arguments and evidence, we conclude Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable as having been obvious over Aizawa, Inokawa, and Ohsaki.

3. Claims 2–9, 11, 13–15, 19–22, and 24–27

Petitioner relies on its arguments from the first ground based on Aizawa and Inokawa in contending that claims 2–9, 11, 13–15, 19–22, and 24–27 are unpatentable under this ground, which adds Ohsaki. *See* Pet. 42; Ex. 1003 ¶ 123–127. In defense of these claims, Patent Owner relies solely on arguments relating to claim 1. *See, e.g.*, PO Resp. 35–39; Ex. 2004 ¶ 86. Thus, for the reasons provided above in relation to the first ground based on Aizawa and Inokawa (all challenged claims) and this ground (claim 1), we conclude Petitioner has demonstrated by a preponderance of the evidence that claims 2–9, 11, 13–15, 19–22, and 24–27 are unpatentable as having been obvious over Aizawa, Inokawa, and Ohsaki.

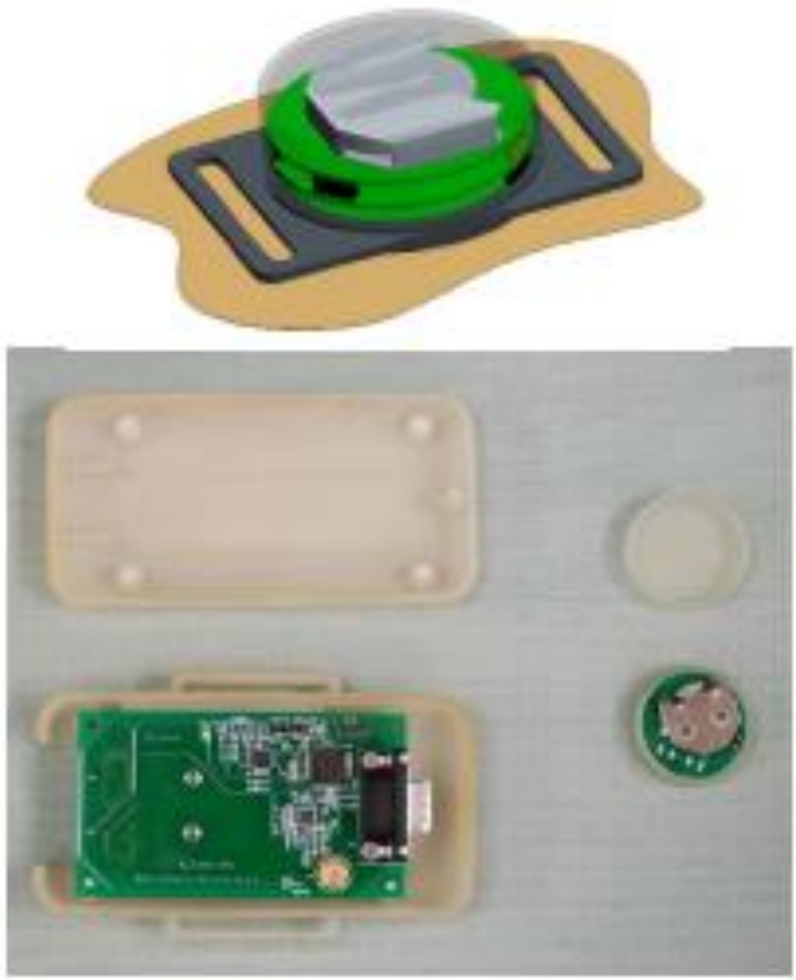
F. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Mendelson-2006

Petitioner contends that claims 16, 27, and 28 are unpatentable based on Aizawa, Inokawa, and Mendelson-2006. Pet. 43–48. Claim 16 depends from claim 1 and recites, "[t]he noninvasive optical physiological sensing system of claim 1 further comprising a touch-screen display." Ex. 1001, 45:38–39. Claim 27 ultimately depends from claim 19 and further recites, "[t]he noninvasive optical physiological sensing system of claim 26, wherein the noninvasive optical physiological sensing system is comprised as part of a mobile monitoring device." *Id.* at 46:43–46. Claim 28 depends from claim 27 and further recites, "[t]he noninvasive optical physiological sensing system of claim 27, wherein the mobile monitoring device includes a touch-screen display." *Id.* at 46:47–49.

1. Mendelson-2006 (Ex. 1016)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1016, 912.[11]

Figure 1 of Mendelson-2006 is reproduced below.



[11] Petitioner cites to the native page numbers that accompany the article, rather than the page numbers added to Exhibit 1016. *See, e.g.*, Pet. 43–45. We follow Petitioner's numbering scheme.

Figure 1 illustrates a sensor module attached to the skin (top), and a photograph of a disassembled sensor module and receiver module (bottom). The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 913.

Figure 2 of Mendelson-2006 is reproduced below.

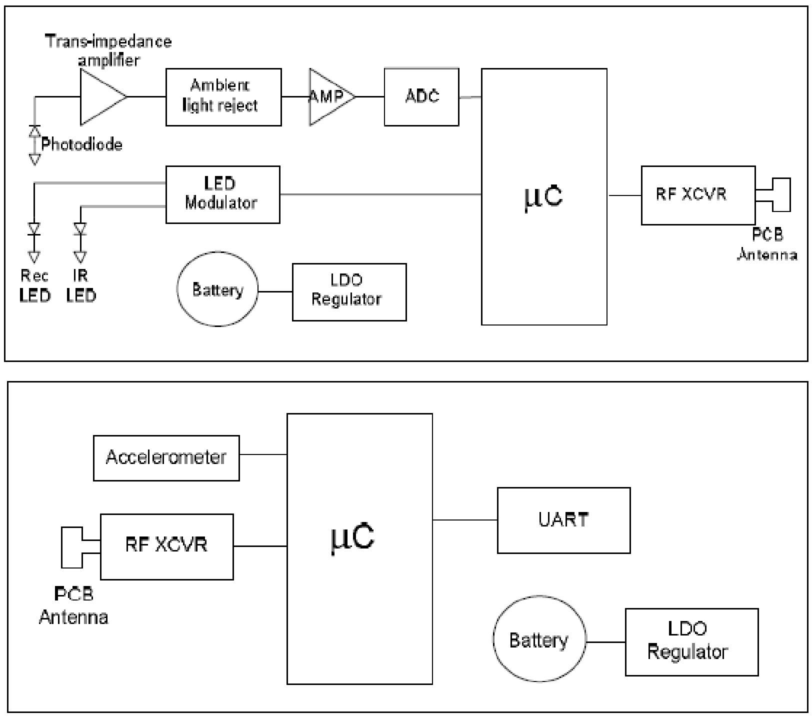


Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module (top) and the receiver module (bottom). *Id.* The sensor module includes at least one light-emitting diode ("LED"), a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 912, 913. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 915. The receiver module includes an embedded microcontroller, an RF transceiver for communicating with the

sensor module, and a wireless module for communicating with the PDA. *Id.* at 913.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 914. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and output information to the user and allows easy activation of various

functions." *Id.* "The GUI also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

2. Analysis

With support from the testimony of Dr. Kenny, Petitioner contends that claims 16, 27, and 28 are unpatentable based on Aizawa, Inokawa, and Mendelson-2006. Pet. 43–48 (citing Ex. 1003 ¶¶ 69–71, 128–136; Ex. 1006 ¶¶ 2, 15, 23, 35; Ex. 1008 ¶ 56; Ex. 1016, 912–914, Figs. 1, 3; Ex. 1022). For instance, Petitioner applies the teachings of Mendelson-2006 to account for the mobile monitoring device features required by claim 27 and the touch-screen display recited in claims 16 and 28. *Id.*

Patent Owner does not separately address this ground urging only that the ground "do[es] not fix the deficiencies" that were alleged in connection with the ground based on Aizawa and Inokawa. PO Resp. 39. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.D.

We have reviewed the parties' papers and supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claims 16, 27, and 28 are unpatentable based on Aizawa, Inokawa, and Mendelson-2006.

G. Obviousness over the Combined Teachings of Aizawa, Inokawa, Mendelson-2006, and Beyer

Petitioner contends that claims 17, 18, and 29 are unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer. Pet. 48–53. Claim 17 depends from claim 1 and recites, "a processor configured to: receive one or

more signals from the at least four detectors, the one or more signals indicative of a physiological parameter of a wearer of the noninvasive optical physiological sensing system; and output information indicative of measurements of the physiological parameter to a mobile phone." Ex. 1001, 45:42–48. Claim 18 depends from claim 17 and further recites, "wherein at least the processor is housed in a mobile monitoring device comprising a touch-screen display." *Id.* at 45:50–51. Claim 29 depends from claim 19 and recites, "[a] physiological monitoring system comprising: the noninvasive optical physiological sensing system of claim 19; and a processor configured to receive the one or more signals and communicate physiological measurement information to a mobile phone." *Id.* at 46:50–55.

1. Overview of Beyer (Ex. 1019)

Beyer is a U.S. patent titled "Cellular Phone/PDA Communication System," and discloses a "cellular PDA communication system for allowing a plurality of cellular phone users to monitor each others' location and status [and] to initiate cellular phone calls." Ex. 1019, code (57). Beyer's Figure 1 is reproduced below.

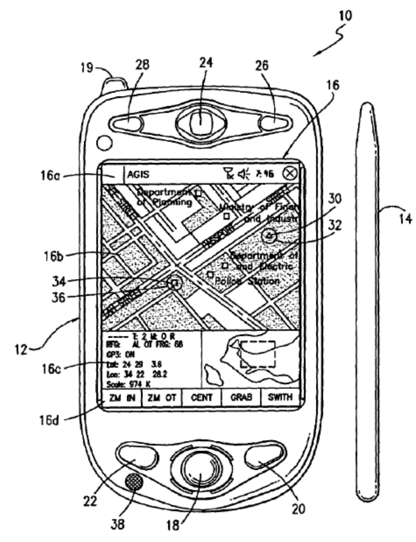


FIG. 1

Figure 1 depicts a "cellular phone/PDA and display." *Id.* at 7:8–9.

2. Analysis

With support from the testimony of Dr. Kenny, Petitioner contends that claims 17, 18, and 29 are unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer. Pet. 48–53 (citing, e.g., Ex. 1003 ¶¶ 138–146; Ex. 1016, 913–914; Ex. 1019, 1:6–15, 7:17–31, Fig. 1). For instance, Petitioner applies the teachings of Beyer to account for showing that "using a PDA that is also a mobile phone . . . was common practice," and that such devices can include a touch-screen display, as required by claim 18. *Id.*

Patent Owner does not separately address this ground urging only that the ground "do[es] not fix the deficiencies" that were alleged in connection with the ground based on Aizawa and Inokawa. PO Resp. 39. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.D.

We have reviewed the parties' papers and supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that

claims 17, 18, and 29 are unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer.

H. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Al-Ali

Petitioner contends that claim 10 is unpatentable over Aizawa, Inokawa, and Al-Ali. Pet. 60–62. Dependent claim 10 ultimately depends from independent claim 1 and recites that "the protruding light permeable cover comprises a conductive layer configured to shield the at least four detectors from noise." Ex. 1001, 45:18–20.

1. Overview of Al-Ali (Ex. 1030)

Al-Ali is a U.S. patent application publication titled "Multiple Wavelength Optical Sensor." Ex. 1030, code (54). Al-Ali discloses an optical sensor with an emitter that radiates light into a tissue site to be received by a detector such that, e.g., oxygen saturation may be derived. *Id.* at code (57). Al-Ali describes detector 1900 having shield 1910 with conductive surface 1920 defining windows, shown below in Figure 19A. *Id.* ¶ 71.

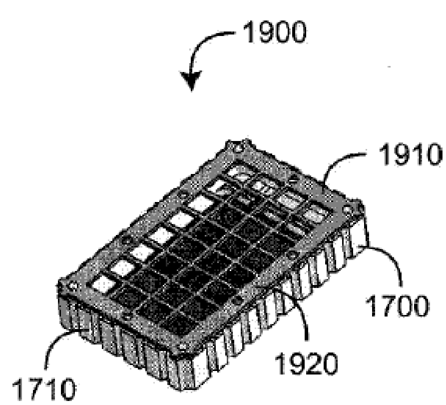


FIG. 19A

Figure 19A depicts a top view of a detector. Al-Ali explains that light is permitted to pass through the windows, while other electromagnetic noise is blocked. *Id*. Al-Ali explains that additional shielding material also can be applied to the ceramic substrate 1710. *Id.*

2. *Analysis*

Petitioner contends that "Al-Ali teaches shielding the detectors of a pulse oximeter/optical sensor by placing a conductive shield 1920 above the housing, thereby providing a Faraday cage that can allow 'passage of light' to the detectors while 'blocking . . . electromagnetic noise.'" Pet. 60–61 (citing Ex. 1030 ¶ 71, Fig. 19A; Ex. 1003 ¶ 162-A). Petitioner asserts this "improve[s] the sensitivity of the detectors, thereby leading to more reliable pulse/signal detection." *Id.* at 61.

According to Petitioner, a person of ordinary skill in the art "would have found it obvious to add a similar conductive shield/layer between the detectors and the LPC [light permeable cover] to prevent electromagnetic noise from reaching the detectors while still allowing desired signals/wavelengths to pass through, thereby reducing the effects of noise and resulting in improved light collection efficiency." *Id.* (citing Ex. 1003 ¶ 162-B). Petitioner contends that this "entails the use of known solutions to improve similar systems and methods in the same way," and "would have led to [the] predictable result of reducing noise and improving signal collection without significantly altering or hindering the functions performed by Aizawa." *Id.* at 62 (citing Ex. 1003 ¶ 162-C).

Patent Owner does not separately address this ground urging only that the ground "do[es] not fix the deficiencies" that were alleged in connection with the ground based on Aizawa and Inokawa. PO Resp. 39. As discussed

above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.D.

We have reviewed the parties' papers and supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claim 5 is unpatentable based on Aizawa, Inokawa, and Al-Ali. Specifically, Al-Ali teaches the use of a conductive material to eliminate noise. Ex. 1030 ¶ 71. In light of this teaching, we credit Dr. Kenny's unrebutted testimony that a person of ordinary skill in the art would have found it obvious to implement such a conductive material in the sensor of Aizawa and Inokawa to also reduce noise, as was a well-known technique in the art. Ex. 1003 ¶¶ 162-A, 162-B.

I. Obviousness over the Combined Teachings of Aizawa, Inokawa, Goldsmith, and Lo

Petitioner contends that claims 16–18 and 27–29 of the '708 patent are unpatentable over Aizawa, Inokawa, Goldsmith, and Lo. Pet. 53–60.

Because we have already determined that these claims are unpatentable, we need not reach this additional ground applied to these claims. *See Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020); *see supra* §§ II.F–G.

J. Obviousness over the Combined Teachings of Mendelson-1988 and Inokawa

Petitioner contends that claims 1–9, 11–15, and 19–26 of the '708 patent would have been obvious over the combined teachings of Mendelson-

1988 and Inokawa. Pet. 62–90.[12] We note that this is the only ground to challenge claims 12 and 23 of the ’708 patent.

1. *Overview of Mendelson-1988 (Ex. 1015)*

Mendelson-1988 discloses a pulse oximeter, with an optical reflectance sensor suitable for noninvasive monitoring of a user’s arterial hemoglobin oxygen saturation (SpO_2), via the user’s forehead. *See* Ex. 1015, 167 (title & abstract). Figure 2 is reproduced below:

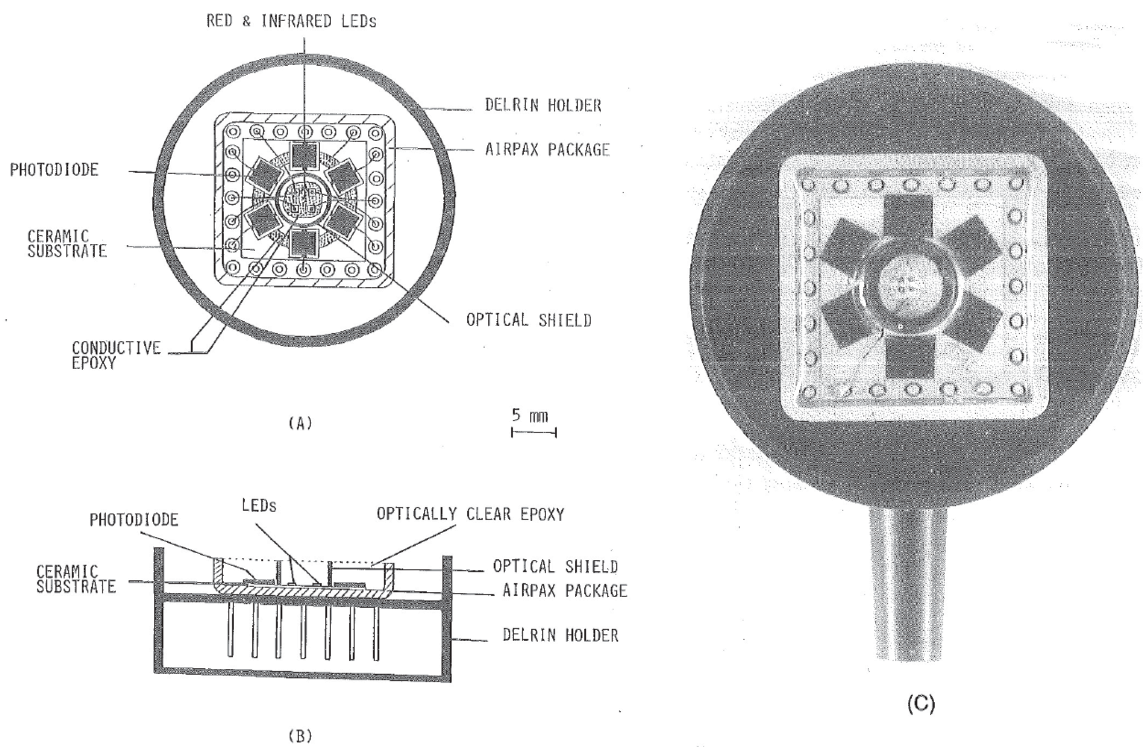


Figure 2 illustrates the sensor of Mendelson-1988, including: (A) a top view diagram; (B) a side view diagram; and (C) a photograph. *Id.* at 169.

---

[12] Petitioner never refers to the ’708 patent in regards to this ground, instead referring to the ’190 patent. We assume that this is an oversight and caused by forgetting to change the patent number in reproducing this Petition after drafting the highly similar petition in IPR2021-00195, which challenges the ’190 patent. As such, we will assume that Petitioner means to refer to the ’708 patent and not the ’190 patent.

The sensor includes two red LEDs and two infrared LEDs for emitting light into the user's tissue, and six photodiodes "arranged symmetrically in a hexagonal configuration" surrounding the four emitters, to detect light reflected back to the sensor from the user's tissue. *Id.* at 168 ("SENSOR DESIGN"). The user's "SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms." *Id.* at 167. "To minimize the amount of light transmission and reflection between the LEDs and the photodiodes within the sensor, a ring-shaped, optically opaque shield of black Delrin . . . was placed between the LEDs and the photodiode chips." *Id.* at 168 (col. 2). "The optical components were encapsulated inside the package using optically clear adhesive." *Id.* "The microelectronic package was mounted inside a black Delrin housing." *Id.*

2. *Independent Claim 1*

i. *"A noninvasive optical physiological sensing system comprising:"*

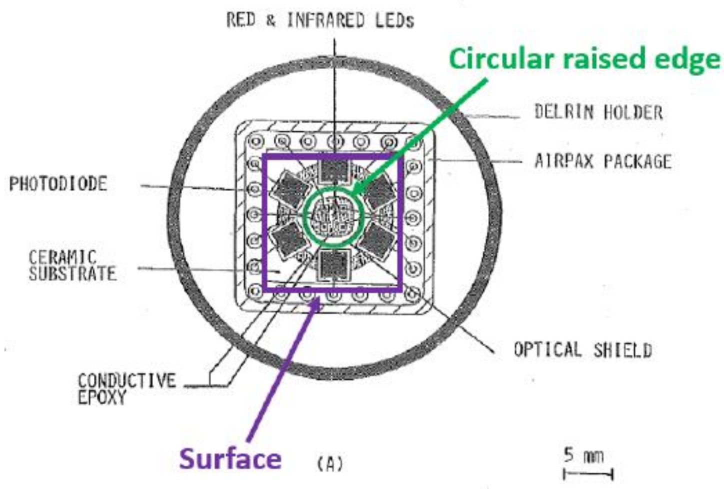
The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses a noninvasive optical physiological measurement system, i.e., an "optical reflectance sensor" that monitors "arterial hemoglobin oxygen saturation [SpO_2]," a physiological parameter of the wearer. Pet. 68; *see, e.g.*, Ex. 1015, 167, 172; Ex. 1003 ¶ 163. Petitioner specifically contends that a person of ordinary skill in the art "would have recognized that a personal computer, together with the pulse oximeter sensor attached to it, provides the claimed sensing system." Pet. 68 (citing Ex. 1003 ¶ 163).

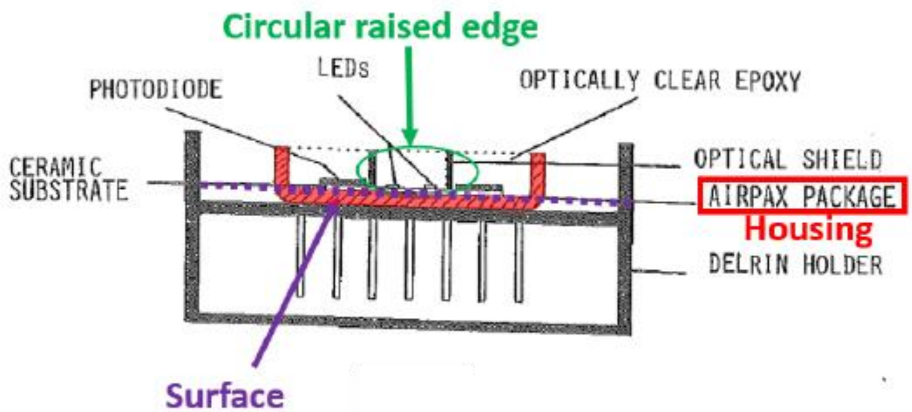
ii. "[a] a platform including a planar surface"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses "LEDs and photodiode chips (i.e., emitters and detectors) [that] are mounted on a ceramic substrate (platform) that has a planar surface." Pet. 68 (citing Ex. 1015, Fig. 2(b), 168) (emphasis omitted); *see, e.g.*, Ex. 1003 ¶ 164.

iii. "[b] a housing including a raised edge portion extending from and enclosing at least a portion of the planar surface"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses an AIRPAX package, i.e., a housing with a ceramic substrate, i.e., a surface, and a circular raised edge extending from the surface. Pet. 69–70. Petitioner's annotated versions of Mendelson-1988's Figures 2A and 2B are reproduced below.





Id. The modified figures depict top and side views of Mendelson-1988's sensor with a housing (depicted in red) having a surface (depicted in purple) with a circular raised edge (depicted in green) extending from the surface. *Id.*; Ex. 1003 ¶¶ 165–166.

> *iv. "[c] at least four detectors arranged on the planar surface of the platform and within the housing, wherein the at least four detectors are arranged in a grid pattern such that a first detector and a second detector are arranged across from each other on opposite sides of a central point along a first axis, and a third detector and a fourth detector are arranged across from each other on opposite sides of the*

central point along a second axis which is perpendicular to the first axis"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1998 discloses "six silicon photodiodes . . . arranged symmetrically in a hexagonal configuration" on the surface. Pet. 70 (citing Ex. 1015, 169, Figs. 2(A)–(B); Ex. 1003 ¶ 167). Petitioner recognizes that Mendelson-1988's "first and second axes as shown above are not perpendicular to each other," but points out that Mendleson-1988 "does not indicate that its system only works with six detectors." Pet. 72 (citing Ex. 1003 ¶ 169; Ex. 1015, 168). According to Petitioner, "a POSITA would have considered using different numbers of spaced-apart detectors, namely 4 or 8, to be obvious and a routine and conventional design choice." *Id.* at 74 (citing Ex. 1006 ¶ 32; Ex. 1003 ¶ 171).

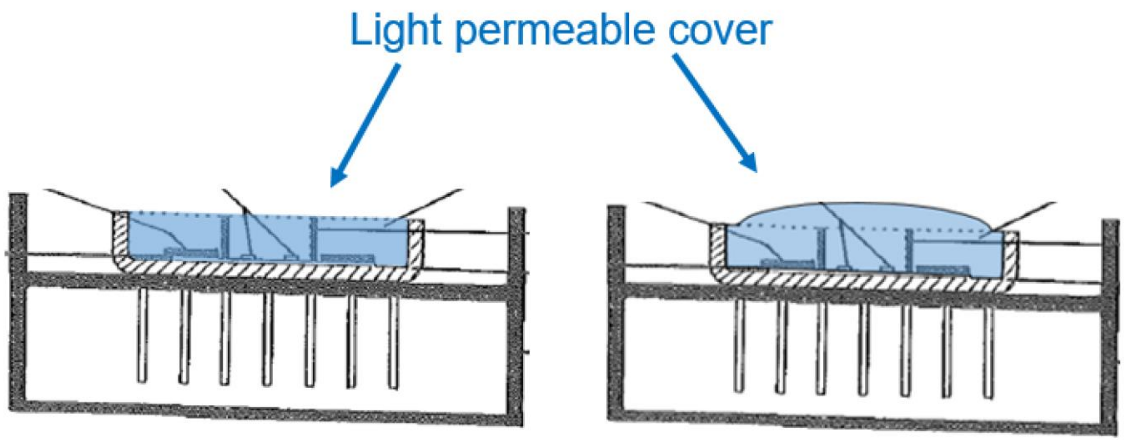
v. "[d] the housing including a protruding light permeable cover"

(1) Petitioner's Contentions

Petitioner contends that Mendelson-1988's sensor discloses all limitations of claim 1, except that its light permeable cover that is arranged above a portion of the housing and covers the detectors, i.e., the "OPTICALLY CLEAR EPOXY" in Figure 2B, lacks the claimed "protrusion." *See* Pet. 64–67, 74–75; Ex. 1003 ¶¶ 172–181. As discussed above in Section II.D.3, Petitioner contends that Inokawa's sensor includes lens 27, comprising a convex protrusion arranged to cover its light detector 25. Pet. 65. Petitioner reasons that an ordinarily skilled artisan would have been motivated, with a reasonable expectation of success, to modify Mendelson-1988's optical SpO_2 sensor, in light of Inokawa's optical

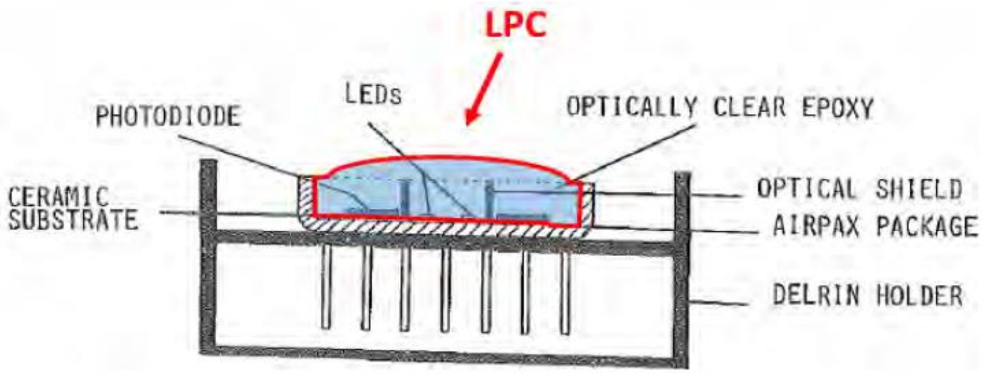
pulse sensor, by adding a lens with a protrusion to Mendelson-1988's cover to improve the sensor's light detection efficiency. *Id.*

Dr. Kenny provides the following illustrations to portray the proposed modification of Mendelson-1988's sensor (Ex. 1003 ¶ 176):

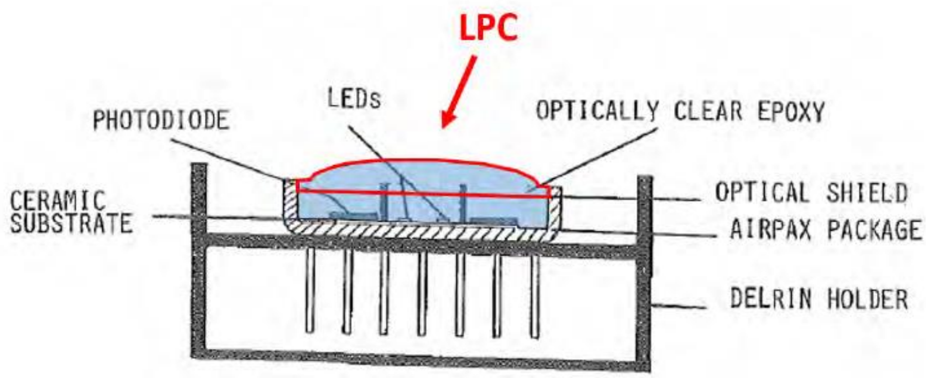


At the left, Dr. Kenny has excerpted and annotated Mendelson-1988's Figure 2B, to identify the pre-existing cover (colored blue) which covers the light emitters and detectors. *See id.* At the right, Dr. Kenny has illustrated the device resulting from the proposed modification of the cover to have a protrusion (also colored blue). *See id.*

Petitioner further asserts "there are two alternative ways of identifying the claimed 'light permeable cover,' or LPC," to the modified cover above. Pet. 74; Ex. 1003 ¶¶ 172–173. Dr. Kenny provides the following two annotations of Mendelson-1988's Figure 2B to identify these alternative mappings:



APPLE-1015, FIG. 2(B)



APPLE-1015, FIG. 2(B).

Dr. Kenny's first mapping (top figure) equates the cover to the entire depth of the epoxy contained within the AIRPAX package as shown in red outline. Ex. 1003 ¶ 180. Dr. Kenny's second mapping (bottom figure) equates the cover to a partial depth of the epoxy within the package as shown in red outline. *Id.* ¶ 181 ("[A person of ordinary skill in the art] would have been able to use the top portion of the housing . . ., as in Nishikawa, to help form the LPC portion on top of the sealing portion.").

Petitioner adds that a person of ordinary skill in the art "would have realized that the epoxy layer [of Mendelson-1998] could have been given a shape that would help further advance Mendelson-1988's objective of improving detection efficiency," "requir[ing] only routine knowledge of

sensor design and assembly." Pet. 64, 66 (citing Ex. 1015, 168, 173); Ex. 1003 ¶¶ 173, 177. For example, "as demonstrated by Nishikawa, molding clear epoxy, as in Mendelson-1988, into a lens was well understood." Pet. 66–67 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35; Ex. 1003 ¶ 178).

(2) Patent Owner's Arguments

Patent Owner is of the view that Petitioner has not met its burden to demonstrate the obviousness of modifying Mendelson-1988's sensor in light of Inokawa to have a protrusion, based on substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. *See* PO Resp. 39–52; Ex. 2004 ¶¶ 91–115; *supra* Section II.D.3. For example, Mendelson-1988, like Aizawa, provides a central emitter or emitters surrounded by several detectors. *Compare* Ex. 1015, 169 (Fig. 2) (showing four central LEDs surrounded by six photodiodes), *with* Ex. 1006, Figs. 1(a)–1(b) (showing one central LED 21 surrounded by four photodetectors 22).

Patent Owner argues that Mendelson-1988 discloses only that it encapsulates its electronic components with a flat optically clear adhesive/epoxy, which is not a "cover." PO Resp. 45 (citing Ex. 1004 ¶¶ 102–103). Patent Owner contends that the '708 patent distinguishes between resin and covers. PO Resp. 45–46 (citing Ex. 1001, 36:37–46; Ex. 2009, 395:22–396:17). Patent Owner also argues that Nishikawa, on which Petitioner relies, "never mentions a cover, and instead discusses encapsulation of components using an integrally molded resin." *Id.* at 46 (citing Ex. 1023 ¶ 35; Ex. 2004 ¶ 104). Likewise, Patent Owner characterizes Inokawa's cover as a "***distinct structure***, not an

undifferentiated mass of resin on a surface." *Id.* (citing Ex. 1008 ¶ 103, Fig. 17).

Patent Owner also objects to Petitioner's alternative mapping, providing for a cover with a protrusion to be found in two different ways. *See* PO Resp. 46–48; Ex. 2004 ¶¶ 105–107. This alternative mapping, according to Patent Owner, is "ambiguous[]," and the second mapping incorporates an "arbitrary" drawn line defining the bottom of the cover in "an ***undifferentiated*** mass of material." PO Resp. 47. Patent Owner also argues that "Petitioner's inability to consistently identify a 'cover' reveals the hindsight-driven nature of its arguments." *Id.*

(3) Petitioner's Reply

Petitioner maintains that the Petition and supporting testimony adequately account for the "cover" required by the claims of the '708 patent, including the "alternative mapping" configuration. Pet. Reply 19–23.

(4) Patent Owner's Sur-reply

Patent Owner's Sur-reply generally reiterates its arguments challenging Petitioner's contentions. PO Sur-reply 18–23.

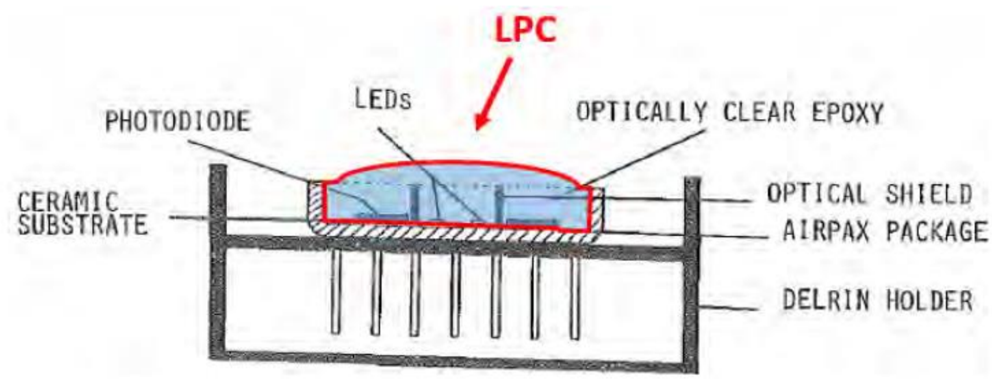
(5) Analysis

As an initial matter, we find that a preponderance of the evidence establishes that the Mendelson-1988 sensor's optically clear epoxy is a light permeable cover that is arranged above a portion of the housing and covers the sensor's detectors. In particular, it is clear from Figures 2A and 2B that the epoxy extends from the top of the sensor at the dotted line in the figure, down into the well of the AIRPAX package, to cover all four LEDs and all six photodiodes disposed at the bottom of the well. *See also* Ex. 1015, 168

("The optical components were encapsulated inside the package using optically clear adhesive"). Although Patent Owner disagrees, that disagreement is premised on its proposed claim construction of the term "cover" as excluding resins and epoxies. *See* PO Resp. 45–48. For reasons provided in Section II.C.1 above, we do not find that claim construction persuasive, and Patent Owner does not distinguish Mendelson-1988 from claim 1 on this basis.

Thus, we determine that Petitioner has established persuasively that Mendelson-1988's sensor teaches every limitation of claim 1, except that its light permeable cover has a flat surface and, thus, does not include a "protrusion." We, however, conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the top surface of Mendelson-1988's cover to include a protrusion, in order to increase the amount of backscattered light that will be received by Mendelson-1988's peripheral detectors. Our reasoning is substantially identical to the analysis provided above in connection with the ground based on Aizawa and Inokawa, with Mendelson-1988 replacing Aizawa in the combination. *See supra* Section II.D.3. Patent Owner does not cite, and we do not discern, any material difference between Mendelson-1988 and Aizawa that might lead to a different result here, with one possible exception.

That difference is Petitioner's alternative mapping of the claimed "cover" to Petitioner's proposed modification of Mendelson-1988's sensor. We rely on the first mapping, but not Petitioner's second mapping, to decide in Petitioner's favor. Petitioner's first mapping is again reproduced here (Ex. 1003 ¶ 180):



APPLE-1015, FIG. 2(B)

In this modified and annotated version of Figure 2B of Mendelson-1988, Dr. Kenny identifies how Mendelson-1988's light permeable cover may be modified to have a protrusion, wherein the cover (which Dr. Kenny has colored blue) includes the entire depth of the optically clear epoxy contained within the AIRPAX package (as Dr. Kenny has shown in red outline). *Id.*; Pet. 74–75. Patent Owner objects to this mapping as ambiguous, but we determine Dr. Kenny's annotations reproduced above are sufficiently clear to establish obviousness by a preponderance of the evidence.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

3. Independent Claim 19

Independent claim 19 consists of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:36–50, *with id.* at 45:53–46:11 (reciting a "housing including a raised wall protruding"). In asserting that claim 19 also would have been obvious over the combined

teachings of Aizawa and Inokawa, Petitioner refers to substantially the same contentions presented as to claim 1. *See* Pet. 85–88; Ex. 1003 ¶¶ 199–202.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 39–48; *see, e.g., id.* at 45 ("Like the Aizawa grounds, Petitioner's Mendelson grounds do not satisfy all of the claim limitations. Claims 1 and 19 include a housing and a light permeable cover.") (citing Ex. 1001, 44:36–50, 45:53–46:11).

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 19 would have been obvious over the cited combination of references. *See supra* §§ II.J.2.i–v; Ex. 1003 ¶¶ 172–181.

4. Dependent Claim 3

Claim 3 ultimately depends from claim 1 and recites, "[t]he noninvasive optical physiological sensing system of claim 2, wherein the housing is a cylindrical housing protrusion." Ex. 1001, 44:57–59. Petitioner recognizes that Mendelson-1988's "particular housing shape . . . appears to have a generally rectangular shape, not a cylindrical one." Pet. 77–78 (citing Ex. 1015, Fig. 2(a)). However, Petitioner contends that a person of ordinary skill in the art "would have recognized that microelectronic packaging as used in Mendelson-1988 comes in various shapes and sizes." *Id.* at 78 (citing Ex. 1003 ¶ 185). Petitioner further contends that a person of ordinary skill in the art "would have considered using a differently shaped housing, namely a cylindrical one, to be obvious," and doing so "was common practice" prior to the '708 patent. *Id.* at 78–79 (citing Ex. 1003 ¶ 186).

Petitioner explains that its contentions are evidenced by another reference of record, Mendelson '799.[13] *Id.*

Patent Owner characterizes Petitioner's proposed ground for claim 3 as "facially deficient" for several reasons: (1) "Petition[er] never identifies a motivation to pick a cylindrical-shaped housing instead of the existing square shape"; (2) "[a person of ordinary skill in the art] would have no particular motivation to change the shape unless a [person of ordinary skill in the art] perceived some benefit in doing so"; (3) "Mendelson '799 does not disclose a cover (or even epoxy encapsulation) and thus cannot disclose a cylindrical housing and a cover of the cylindrical housing, as claim 3 requires"; and (4) "Petitioner did not include Mendelson '799 in any ground." PO Resp. 48–49 (citing Ex. 2004 ¶¶ 110–111).

In response to Patent Owner's arguments, Petitioner replies that "references like Mendelson [']799 have a circular housing and confirm the notion that a [person of ordinary skill in the art] would have found it to be simply a matter of design choice to use different shapes." Pet. Reply 23 (citing Ex. 1003 ¶ 186; Ex. 1025, Fig. 7, 9:34–36; Ex. 1047 ¶ 48). Petitioner also contends "neither the '708 patent nor [Patent Owner] provides any explanation of how the particular housing shape solves some problem or presents some unexpected result." *Id.* at 23–24 (citing *In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975)).

Patent Owner responds that "Petitioner's reply reiterates its conclusory arguments that [the proposed] change would be routine, without

---

[13] U.S. Patent No. 6,801,799 B2, filed Feb. 6, 2003, issued Oct. 5, 2004 ("Mendelson 799," Ex. 1025).

identifying any reason to modify the shape from square to circular." Sur-reply 21–22.

On the record before us, we conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the shape of Mendelson-1988's AIRPAX package from square to circular. Petitioner's and Dr. Kenny's general assessment that a person of ordinary skill in the art would have been aware that a circular housing shape was a known option for housing of components of a physiological sensor finds support in the record. Pet. 77–78; Ex. 1003 ¶ 186. In that respect, although Mendelson '799 was not listed in the styling of the proposed grounds of unpatentability based on Mendelson-1988 and Inokawa, its teachings plainly were offered in the Petition as evidence of the background knowledge that an ordinarily skilled artisan would have brought to bear in an evaluation of the teachings Mendelson-1988 and Inokawa. Pet. 77–78. Moreover, it is clear that Patent Owner understood that the proposed ground offered in the Petition took into account the disclosure of Mendelson '799, and Patent Owner had opportunity to address that disclosure. Indeed, Patent Owner availed itself of that opportunity during trial (*see*, *e.g.*, PO Resp. 48–49; Sur-reply 21–22).

We further find unavailing Patent Owner's argument that "Mendelson '799 does not disclose a cover (or even epoxy encapsulation) and thus cannot disclose a cylindrical housing and a cover of the cylindrical housing, as claim 3 requires." PO Resp. 49. Figure 7 of Mendelson '799 is reproduced below:

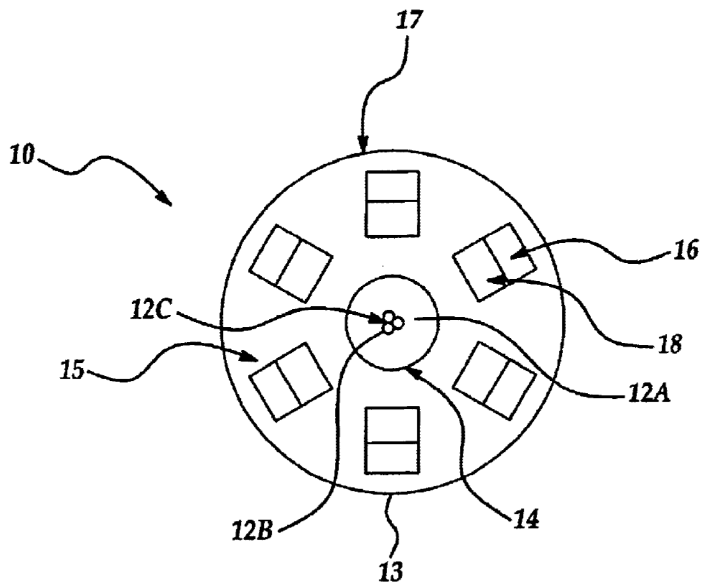


Figure 7

Figure 7 is a top view of optical sensor 10 comprising light source 12 composed of three LEDs 12A, 12B, and 12C emitting light of three different wavelengths, and an array of six near detectors 18 and six far detectors 16 "arranged in two concentric ring-like arrangements" surrounding light source 12. Ex. 1025, 9:23–34. "All these elements are accommodated in a sensor housing 17" which, as can be seen in Figure 7, is clearly circular. *Id.* at 9:34–35. Patent Owner does not articulate why the presence or absence of a cover in Mendelson '799 somehow serves to discount Mendelson '799's unambiguous presentation of a sensor housing having a shape recognizable as circular.

Furthermore, one of ordinary skill in the art would have understood that the AIRPAX package of Mendelson-1988 and the housing 17 of Mendelson '799 are performing the same function of enclosing a central collection of light emitters which are surrounded by an array of light detectors in an optical sensor attached to a user's body. *See, e.g.*, Ex. 1015, Figs. 2A–2B; Ex. 1025, Fig. 7. The evidence of record also does not suggest

that the shape of such a housing has any functional significance in the operation of the optical sensor, or that any particular known shape was preferred or restricted. Thus, the evidence suggests that a square shape and a circular shape of such a housing were known in the art to be predictable substitutes for one another, and therefore obvious variants. *See, e.g.*, *KSR*, 550 U.S. at 416 ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."); *id.* at 417 ("[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." (citation omitted)).

We conclude Petitioner has demonstrated by a preponderance of the evidence that Petitioner's ground based on Mendelson-1988 and Inokawa conveys the unpatentability of claim 3.

5. Dependent Claims 2, 4–9, 11–15, and 20–26

Petitioner provides argument and evidence, including testimony from Dr. Kenny, in support of its position that claims 2, 4–9, 11–15, and 20–26 are unpatentable over Mendelson-1988 and Inokawa. Pet. 76–77, 79–85, 88–90 (citing, e.g., Ex. 1003 ¶¶ 163–209). Patent Owner does not advance any arguments for claims 2, 4–9, 11–15, and 20–26, that are distinct from those provided for claims 1, 3, and 19. *See* PO Resp. 52. For the same reasons set forth in Sections II.J.2–4 above, we find Patent Owner's arguments unavailing as to claims 2, 4–9, 11–15, and 20–26. Having evaluated the Petition and its underlying supporting evidence, we conclude that Petitioner has established by a preponderance of the evidence that

claims 2, 4–9, 11–15, and 20–26 are also unpatentable based on Mendelson-1988 and Inokawa.

K. Obviousness over the Combined Teachings of Mendelson-1988, Inokawa, and Mendelson-2006

Petitioner contends that claims 16, 27, and 28 of the ’708 patent would have been obvious over the combined teachings of Mendelson-1988, Inokawa, and Mendelson-2006. Pet. 90–93.

With support from the testimony of Dr. Kenny, Petitioner contends that claims 16, 27, and 28 are unpatentable based on Mendelson-1988, Inokawa, and Mendelson-2006. Pet. 90–93 (citing Ex. 1003 ¶¶ 129, 210–216; Ex. 1015, 167, 169, Fig. 2; Ex. 1016, 912–915, Figs. 1–3). For instance, Petitioner applies the teachings of Mendelson-2006 to account for the mobile monitoring device features required by claim 27 and the touch-screen display recited in claims 16 and 28. *Id.*

Patent Owner does not separately address this ground urging only that the ground “do[es] not fix the Petition’s deficiencies” that were alleged in connection with the ground based on Mendelson-1988 and Inokawa. PO Resp. 52. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.J.

We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claims 16, 27, and 28 are unpatentable based on Mendelson-1988, Inokawa, and Mendelson-2006.

L. Obviousness over the Combined Teachings of Mendelson-1988, Inokawa, Mendelson-2006, and Beyer

Petitioner contends that claims 17, 18, and 29 of the '708 patent would have been obvious over the combined teachings of Mendelson-1988, Inokawa, Mendelson-2006, and Beyer. Pet. 93–96.

With support from the testimony of Dr. Kenny, Petitioner contends that claims 17, 18, and 29 are unpatentable based on Mendelson-1988, Inokawa, Mendelson-2006, and Beyer. Pet. 93–96 (citing, e.g., Ex. 1003 ¶¶ 72, 217–226; Ex. 1016, 912–915; Ex. 1019, 7:17–31, Fig. 1). The Petition frequently cites back to analysis for previously addressed grounds in explaining the arguments for this ground, as this ground contains many of prior art references and claims that were previously addressed in various capacities within the proposed grounds. *See, e.g.*, *id.* at 94 (analyzing claim 17 and writing "as discussed in Section III.H.1, the combined system of Mendelson-1988-Inokawa-Mendelson-2006 can rely on the receiver module of Mendelson-2006 to receive signals from Mendelson-1988's sensor and communicate with a PDA"). Petitioner further applies the teachings of Beyer to, for example, show that a person of ordinary skill in the art "would have considered using a different PDA than the one mentioned in Mendelson-2006, namely the cellular PDA of Beyer, to be obvious and a routine/conventional design choice," as required by claim 17. *Id.* at 94–95 (citing Ex. 1003 ¶¶ 72, 221–222; Pet. 48–53).

Patent Owner does not separately address this ground urging only that the ground "do[es] not fix the Petition's deficiencies" that were alleged in connection with the ground based on Mendelson-1988 and Inokawa. PO Resp. 52. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.J.

We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claims 17, 18, and 29 are unpatentable based on Mendelson-1988, Inokawa, Mendelson-2006, and Beyer.

III. CONCLUSION

In summary, we determine that a preponderance of the evidence establishes claims 1–29 of the '708 patent are unpatentable, as shown in the following table:[14]

Claim(s)	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–9, 11, 13–15, 19–22, 24–27	103	Aizawa, Inokawa	1–9, 11, 13–15, 19–22, 24–27	
1–9, 11, 13–15, 19–22, 24–27	103	Aizawa, Inokawa, Ohsaki	1–9, 11, 13–15, 19–22, 24–27	
16, 27, 28	103	Aizawa, Inokawa, Mendelson-2006	16, 27, 28	
17, 18, 29	103	Aizawa, Inokawa, Mendelson-2006, Beyer	17, 18, 29	

[14] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. §§ 42.8(a)(3), (b)(2).

16–18, 27–29	103[15]	Aizawa, Inokawa, Goldsmith, Lo		
10	103	Aizawa, Inokawa, Al-Ali	10	
1–9, 11–15, 19–26	103	Mendelson-1988, Inokawa	1–9, 11–15, 19–26	
16, 27, 28	103	Mendelson-1988, Inokawa, Mendelson-2006	16, 27, 28	
17, 18, 29	103	Mendelson-1988, Inokawa, Mendelson-2006, Beyer	17, 18, 29	
Overall Outcome			1–29	

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–29 of the ’708 patent have been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

---

[15] As explained above, because we conclude that the challenged claims are unpatentable on other grounds, we do not reach the merits of this ground.

FOR PETITIONER:

W. Karl Renner
Andrew Patrick
Hyun Jin In
Dan Smith
FISH & RICHARDSON P.C.
IPR50095-000913IP12@fr.com
PTABInbound@fr.com
axf-ptab@fr.com
patrick@fr.com
in@fr.com

FOR PATENT OWNER:

Joseph R. Re
Stephen W. Larson
Jarom D. Kesler
Jacob L. Peterson
KNOBBE, MARTENS, OLSON, & BEAR, LLP
AppleIPR2021-0193-708@knobbe.com
2jrr@knobbe.com
2swl@knobbe.com
2jzk@knobbe.com
2jup@knobbe.com

Trials@uspto.gov
571-272-7822

Paper 32
Entered: May 25, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2021-00195
Patent 10,376,190 B1

Before JOSIAH C. COCKS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges.*

WIEKER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–14 and 16–30 ("challenged claims") of U.S. Patent No. 10,376,190 B1 (Ex. 1001, "the '190 patent"). Paper 2 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a preliminary response. Paper 6. We instituted an *inter partes* review of all challenged claims 1–14 and 16–30 on all grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 7 ("Inst. Dec.").

After institution, Patent Owner filed a Response (Paper 15, "PO Resp.") to the Petition, Petitioner filed a Reply (Paper 18, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 22, "PO Sur-reply"). An oral hearing was held on March 15, 2022, and a transcript of the hearing is included in the record. Paper 31 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–14 and 16–30 of the '190 patent are unpatentable.

B. Related Matters

The parties identify the following matters related to the '190 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01716 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1)

Apple Inc. v. Masimo Corporation, IPR2021-00193 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,299,708 B1);

Apple Inc. v. Masimo Corporation, IPR2021-00208 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,258,266 B1); and

Apple Inc. v. Masimo Corporation, IPR2021-00209 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,376,191 B1).

Pet. 100; Paper 3, 3–4.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the ’190 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 17/031,407;

U.S. Patent Application No. 17/031,316;

U.S. Patent Application No. 17/031,356;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 3, 1–3.

C. The ’190 Patent

The ’190 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on August 13,

2019, from U.S. Patent Application No. 16/409,304, filed May 10, 2019. Ex. 1001, codes (21), (22), (45), (54). The ’190 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The ’190 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:31–33. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:22–28, 57–58. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:38–40.

Figure 1 of the ’190 patent is reproduced below.

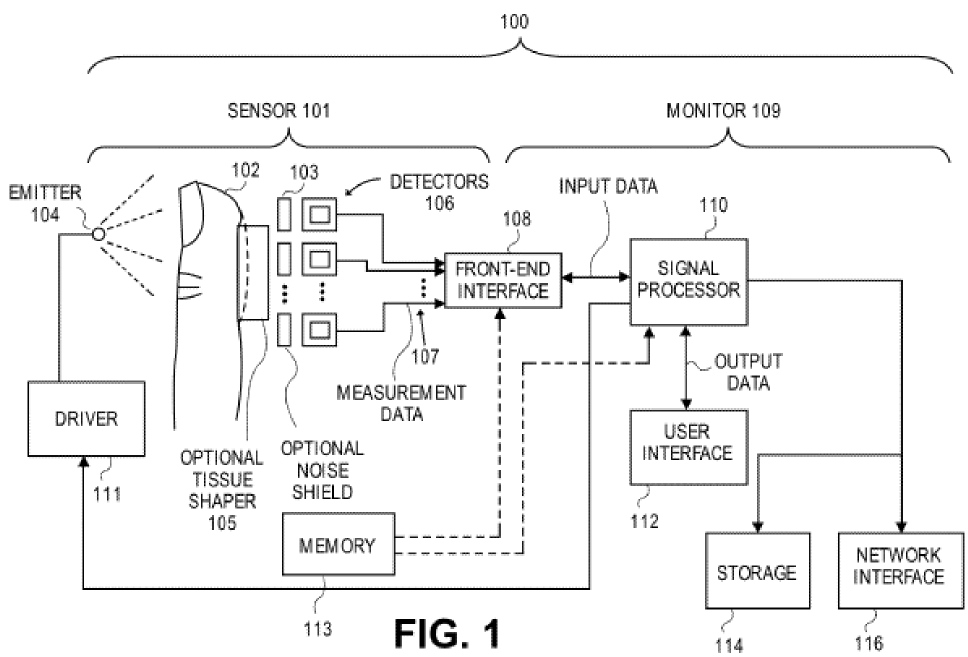


FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:36–47. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:48–52. Emitters 104 emit light that

is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 13:60–67. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 13:64–66, 14:16–22. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 10:61–11:3.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:6–8. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors 106." *Id.* at 15:10–14. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:38–48. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:52–16:3.

The '190 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

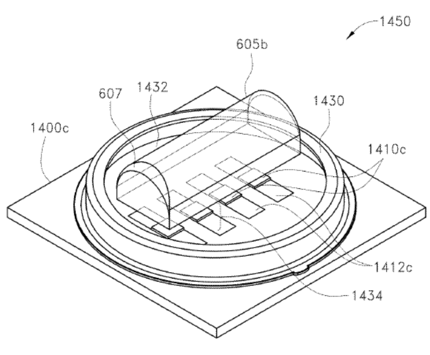


FIG. 14D

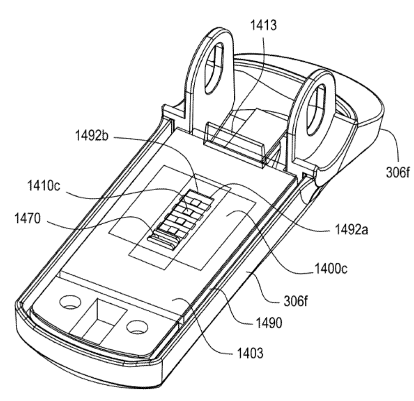


FIG. 14F

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:34–37. As shown in

Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:23–25, 36:17–24. Figure 14F illustrates detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 36:63–37:4. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:34–36.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

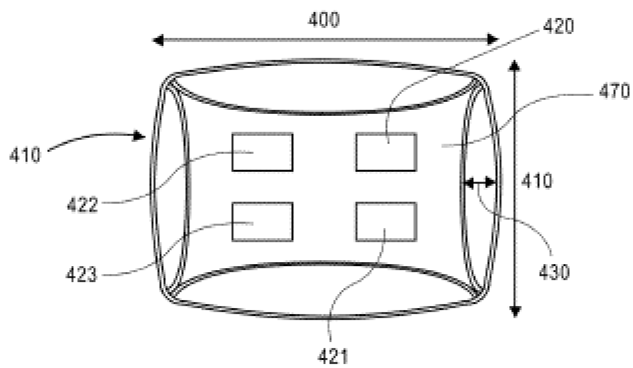


FIG. 4A

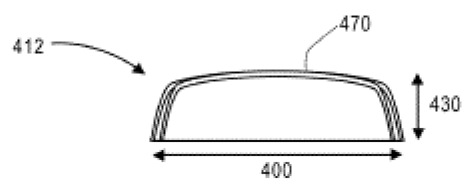


FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:8–14. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:31–33. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:39–53.

D. Illustrative Claim

Of the challenged claims, claims 1 and 26 are independent. Claim 1 is illustrative and is reproduced below.

> 1. A noninvasive optical physiological measurement device adapted to be worn by a wearer, the noninvasive optical physiological measurement device providing an indication of a physiological parameter of the wearer comprising:
>
> [a] one or more light emitters;
>
> [b] a housing having a surface and a circular raised edge extending from the surface;
>
> [c] at least four detectors arranged on the surface and spaced apart from each other, the at least four detectors configured to output one or more signals responsive to light from the one or more light emitters attenuated by body tissue, the one or more signals indicative of a physiological parameter of the wearer; and
>
> [d] a light permeable cover arranged above at least a portion of the housing, the light permeable cover comprising a protrusion arranged to cover the at least four detectors.

Ex. 1001, 44:37–53 (bracketed identifiers [a]–[d] added). Independent claim 26 includes limitations substantially similar to limitations [a]–[d] of claim 1. *Id.* at 46:22–40 (reciting a "circular housing" with a "wall"; reciting a "lens portion").

E. Applied References

Petitioner relies upon the following references:

> Beyer, Jr., U.S. Patent No. 7,031,728 B2, filed Sept. 21, 2004, issued Apr. 18, 2006 (Ex. 1019, "Beyer");
>
> Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1014, "Ohsaki");

Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, "Aizawa");

Lo et al., U.S. Patent Application Publication No. 2004/0138568 A1, filed Jan. 15, 2003, published July 15, 2004 (Ex. 1028, "Lo");

Inokawa et al., Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006 (Ex. 1007, "Inokawa");[1]

Goldsmith et al., U.S. Patent Application Publication No. 2007/0093786 A1, filed July 31, 2006, published April 26, 2007 (Ex. 1027, "Goldsmith");

Al-Ali et al., U.S. Patent Application Publication No. 2008/0242958 A1, filed Mar. 26, 2008, published Oct. 2, 2008 (Ex. 1030, "Al-Ali");

Y. Mendelson et al., "Design and Evaluation of a New Reflectance Pulse Oximeter Sensor," Association for the Advancement of Medical Instrumentation, Vol. 22, No. 4, 167–173 (1988) (Ex. 1015, "Mendelson-1988"); and

Y. Mendelson et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," Proceedings of the 28th IEEE EMBS Annual International Conference, 912–915 (2006) (Ex. 1016, "Mendelson-2006").

Pet. 4. Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003), and the Second Declaration of Thomas W. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Vijay K. Madisetti, Ph.D. (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this and other proceedings. *See* Exs. 1034–1036, 2006–2009, 2027.

[1] Petitioner relies on a certified English translation of Inokawa (Ex. 1008). In this Decision, we also refer to the translation.

F. Asserted Grounds

Petitioner asserts that claims 1–14 and 16–30 are unpatentable based upon the following grounds (Pet. 1–2):

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–14, 16, 17, 19–23, 26–29	103	Aizawa, Inokawa
1–14, 16, 17, 19–23, 26–29	103	Aizawa, Inokawa, Ohsaki
23, 24	103	Aizawa, Inokawa, Mendelson-2006
23–25	103	Aizawa, Inokawa, Goldsmith, Lo
25	103	Aizawa, Inokawa, Mendelson-2006, Beyer
5	103	Aizawa, Inokawa, Al-Ali
1–14, 16–22, 26–30	103	Mendelson-1988, Inokawa
23, 24	103	Mendelson-1988, Inokawa, Mendelson-2006
25	103	Mendelson-1988, Inokawa, Mendelson-2006, Beyer

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019).

Although both parties contend that no claim term requires express construction (Pet. 4–5; PO Resp. 10), the substance of the parties' briefing demonstrates that there is a dispute regarding the claim term "cover."

1. "cover"

Each of independent claims 1 and 26 requires "a light permeable cover." Ex. 1001, 44:51, 46:33.

Patent Owner argues that the claimed "cover" excludes "an optically clear adhesive/epoxy" and a "resin on a surface." PO Resp. 46–47. According to Patent Owner, "the '190 Patent distinguishes a resin on a surface from a cover, explaining: 'the cylindrical housing 1430 (and transparent cover 1432) . . . can protect the detectors 1410c and conductors 1412c ***more effectively*** than currently-available ***resin epoxies***.'" *Id.* at 47 (quoting Ex. 1001, 36:37–46).

Patent Owner alleges that Dr. Kenny also "distinguished a sealing resin from a cover, acknowledging a 'layer of sealing resin' is 'one way to protect the components ***without using a cover***.'" *Id.* (quoting Ex. 2009, 395:22–396:17). Patent Owner argues its understanding is consistent with the prior art cited by Petitioner. *Id.* (citing Ex. 1008 ¶ 103, Fig. 17; Ex. 1023 ¶ 35; Ex. 1012, 5:2–6, Fig. 2B; Ex. 1013 ¶ 32, Fig. 2; Ex. 1027 ¶ 85, Fig. 9B Ex. 2004 ¶ 104).

Petitioner replies that "there is nothing in the specification or the prosecution history [of the '190 patent] that would lead a [person of ordinary skill in the art] to conclude that 'cover' should be interpreted based on anything other than its plain meaning." Pet. Reply 20 (citing *Thorner v. Sony Computer Entertainment America LLC*, 669 F.3d 1362, 1368 (Fed. Cir. 2012)). That plain meaning, according to Petitioner, is that "a cover is merely 'something that protects, shelters, or guards.'" *Id.* at 20–21 (quoting Ex. 1050; citing Pet. 73–75; Ex. 1047 ¶ 43). Petitioner argues that Patent Owner's reliance on the '190 patent Specification takes text out of context

and, when context is considered, it is clear that "the epoxy resin to which the '190 patent compares its cover is not [an] epoxy cover . . . but rather epoxy that is applied to solder joints." *Id.* at 21 (citing Ex. 1001, 36:37–46; Ex. 1047 ¶ 45).

Petitioner also contends that Patent Owner "mischaracterizes Dr. Kenny's deposition testimony to say he agreed that 'sealing resin' is somehow distinguished from a cover." *Id*. Petitioner contends that Dr. Kenny simply "clarified that using a sealing resin is 'a pretty common way to protect electronic components.'" *Id.* (citing Ex. 2009, 395:22–396:17; Ex. 1047 ¶ 44). Moreover, Petitioner contends that "such extrinsic evidence would not justify departure from plain meaning under *Thorner*." *Id.*

In its Sur-reply, Patent Owner maintains that the '190 patent "specifically ***distinguishes*** a 'resin' on a surface from a 'cover,'" and Petitioner's opposing reading is not persuasive. PO Sur-reply 18–19.

Upon review of the record, we disagree with Patent Owner's limiting construction of "cover" to exclude epoxy and resin. The plain and ordinary meaning of the term does not support Patent Owner's view. A "cover" ordinarily connotes "something that protects, shelters, or guards." Ex. 1050 (*Merriam-Webster's Collegiate Dictionary*, 11th ed. (©2005)), 288. That plain and ordinary meaning is consistent with the '190 patent's description of "flex circuit cover 360, which can be made of plastic or another suitable material . . . [and] can cover and thereby protect a flex circuit (not shown)." Ex. 1001, 22:62–66. It is also consistent with the '190 patent's description and illustration of "transparent cover 1432" in Figure 14D, which covers and protects detectors 1410c and conductors 1412c, and which "can be

fabricated from glass or plastic, *among other materials*." *See id.* at 36:22–36 (emphasis added), Figs. 14D–14E.

This is not the situation in which a special definition for a claim term has been set forth in the specification with reasonable clarity, deliberateness, and precision, so as to give notice of the inventor's own lexicography. *See Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005); *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Nor do we discern that Patent Owner "demonstrate[d] an intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope." *Teleflex, Inc. v. Ficosa North America Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002).

Here, based upon our review of the intrinsic evidence, no such special definition or express disavowal of the term "cover" to exclude epoxy and resin exists. Patent Owner relies on the following description of Figure 14D in that regard:

> *In certain embodiments, the cylindrical housing 1430 (and transparent cover 1432)* forms an airtight or substantially airtight or hermetic seal with the submount 1400c. As a result, the cylindrical housing 1430 can protect the detectors 1410c and conductors 1412c from fluids and vapors that can cause corrosion. Advantageously, *in certain embodiments, the cylindrical housing 1430 can protect* the detectors 1410c and conductors 1412c *more effectively than currently-available resin epoxies*, which are sometimes applied to solder joints between conductors and detectors.

Ex. 1001, 36:37–46 (emphases added). First, the sentence cited by Patent Owner begins with the phrase "[i]n certain embodiments," which indicates the claimed invention is not limited and is open to other embodiments, so there is no lexicography or disavowal here. Second, we agree with

Petitioner's reading of this passage as distinguishing the prior art from the claimed invention based on the *location* of the material (applied only to solder joints between conductors and detectors in the prior art, as opposed to covering the conductors and detectors in the invention) and not the *type* of material. Third, at best, the '190 patent expresses a preference for a cover to be made of glass or plastic, because such materials provide "more effective[]" protection than resin epoxies that were known when the '190 patent was filed. *See id.* at 36:42–46. But even this reading recognizes that resin epoxies provide some amount of protection, albeit perhaps a lesser amount than glass or plastic, and are not excluded from forming the material of a cover.

Dr. Kenny's deposition testimony cited by Patent Owner also does not persuade us that, in the context of the '190 patent, epoxy or resin is excluded from the material of a cover. Dr. Kenny testifies that "a layer of sealing resin" "[c]ould" be used to protect the electronic components in a sensor (Ex. 2009, 395:22–396:8). He was then asked "So that would be one way to protect the components without using a cover, correct?" to which he answered "[t]here are many ways to protect the elements other than using a cover" and maintained that the proposed combination of prior art has a "cover" to achieve purposes *other than* protecting electronic components, i.e., "to improve adhesion and to improve light gathering for the operation of the system." *Id.* at 396:9–17. He did not squarely testify that sealing resin may never be a cover.

Accordingly, in the context of the '190 patent, we do not construe the claimed "cover" to exclude epoxy and resin.

2. Other Claim Terms

Upon consideration of the entirety of the arguments and evidence presented, we conclude no further explicit construction of any claim term is needed to resolve the issues presented by the arguments and evidence of record. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (per curiam) (claim terms need to be construed "only to the extent necessary to resolve the controversy" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art

[2] Patent Owner does not present objective evidence of non-obviousness.

elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 5 (citing Ex. 1003 ¶¶ 21–22). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.*

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 10–11 (citing Ex. 2004 ¶¶ 35–38).

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Aizawa and Inokawa

Petitioner contends that claims 1–14, 16, 17, 19–23, and 26–29 of the ’190 patent would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 8–42.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled “Pulse Wave Sensor and Pulse Rate Detector,” and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient’s artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

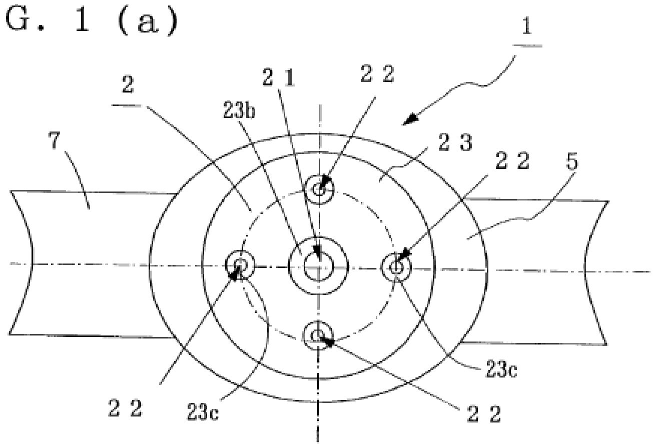


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode (“LED”) 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, “to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased.” *Id.* ¶ 32, Fig. 4(a). “The same effect can be obtained when the number of photodetectors 22 is [one] and a

plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

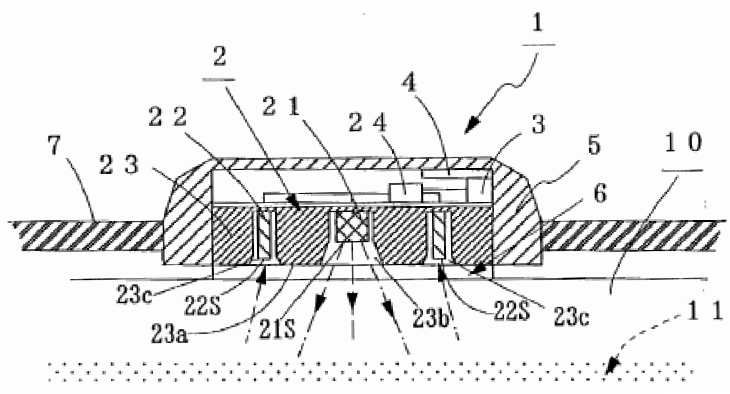


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* ¶ 23. Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.* ¶ 23.

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* ¶ 24. Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting

face 21s of the light emitting diode 21 faces down (on the wrist 10 side).” *Id.* ¶ 26. Furthermore, “the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved.” *Id.* ¶¶ 26, 34.

2. Overview of Inokawa (Ex. 1008)

Inokawa is a Japanese published patent application titled “Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method,” and discloses a pulse sensor device. Ex. 1008 ¶ 6.

Figure 1 of Inokawa is reproduced below.

(FIG. 1)

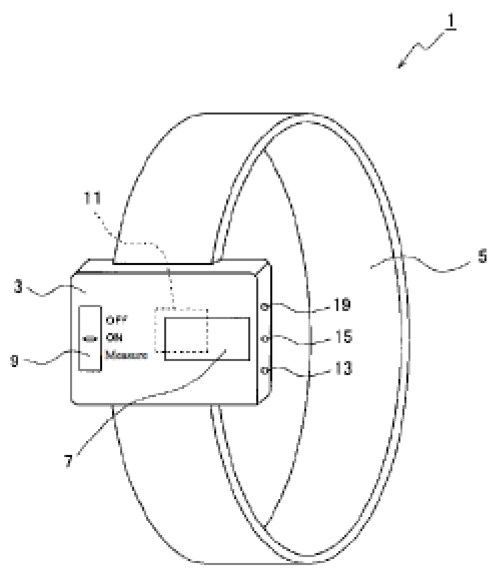


Figure 1 illustrates a schematic view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user’s pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

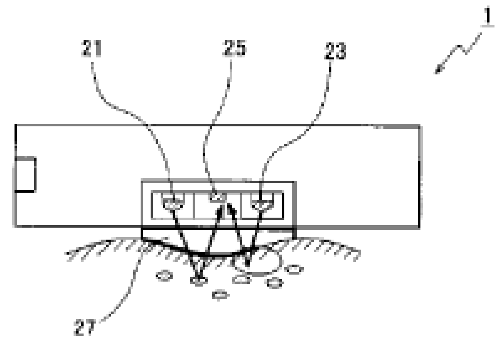


Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of light-emitting elements, i.e., green LED 21 and infrared LED 23, as well as photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 senses "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 senses body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory 63." *Id.* ¶ 69.

Figure 3 of Inokawa is reproduced below.

(FIG. 3)

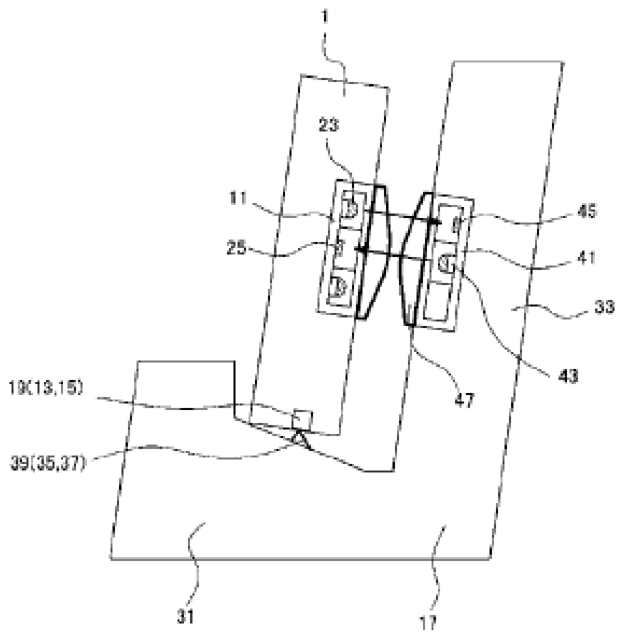


Figure 3 illustrates a schematic view of a pulse sensor mounted to a base device. *Id.* ¶ 60. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* When so mounted, sensor optical device component 11 and base optical device component 41 face each other in close proximity. *Id.* ¶ 66. In this position, pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76. In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 13–17 (combination), 17–23 (claim 1).

i. "A noninvasive optical physiological measurement device adapted to be worn by a wearer, the noninvasive optical physiological measurement device providing an indication of a physiological parameter of the wearer comprising"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses a noninvasive optical physiological measurement device, i.e., a pulse sensor worn on a wearer's wrist, that indicates a physiological parameter of the wearer. Pet. 17; *see, e.g.*, Ex. 1006 ¶ 2 ("[A] pulse wave sensor for detecting the pulse wave of a subject from light reflected from a red corpuscle in the artery of a wrist of the subject by irradiating the artery of the wrist with light.").

ii. "[a] one or more light emitters"

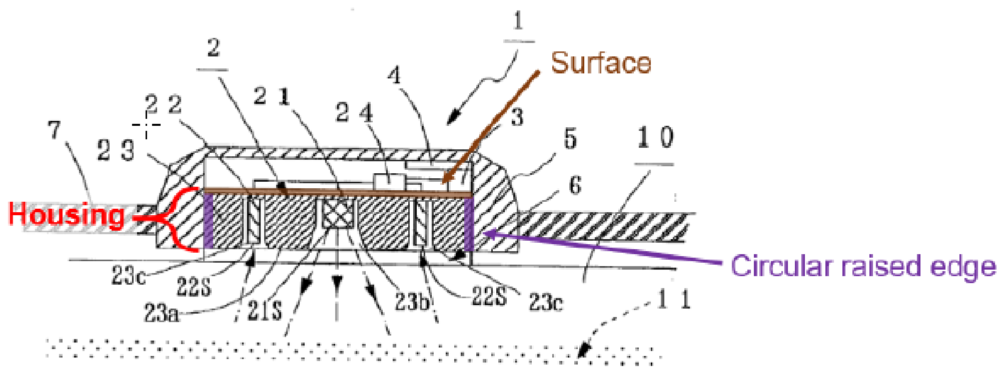
The cited evidence supports Petitioner's undisputed contention that Aizawa discloses LED 21 that emits light. Pet. 17–18; *see, e.g.*, Ex. 1006 ¶ 23 ("LED 21 . . . for emitting light having a wavelength of a near infrared range"), Figs. 1(a)–(b).

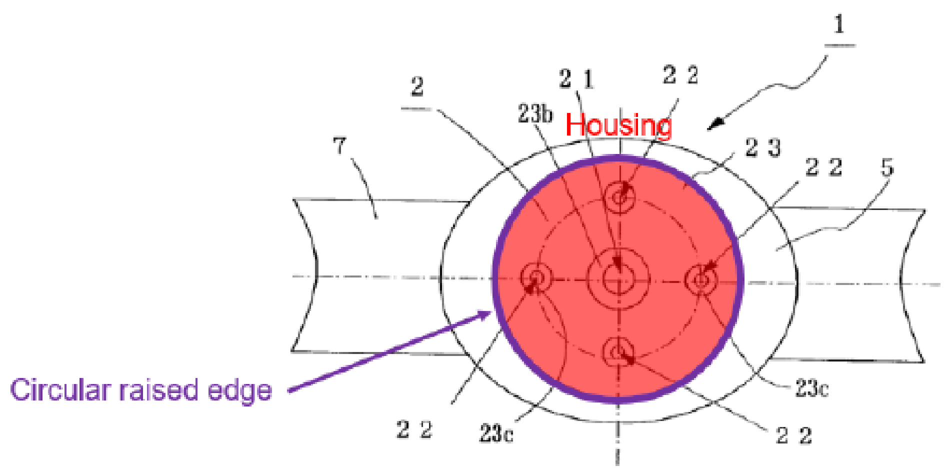
iii. "[b] a housing having a surface and a circular raised edge extending from the surface"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23, which includes a flat surface and a circular raised edge extending from the surface. Pet. 18–19; *see, e.g.*, Ex. 1006 ¶ 23

("holder 23 for storing . . . light emitting diode 21 and the photodetectors 22"), Figs. 1(a)–(b) (depicting holder 23 surrounding each detector 22); Ex. 1003 ¶¶ 75–76.

Petitioner's annotated versions of Aizawa's Figures 1(a) and 1(b) are reproduced below.





Pet. 18–19. The modified figures depict side and top views of Aizawa's sensor with the housing identified in red shading, the circular raised edge identified in purple, and the surface depicted in brown. *Id.*

iv. *"[c] at least four detectors arranged on the surface and spaced apart from each other, the at least four detectors configured to output one or more signals responsive to light from the one or more light emitters attenuated by body tissue, the one or more signals indicative of a physiological parameter of the wearer"*

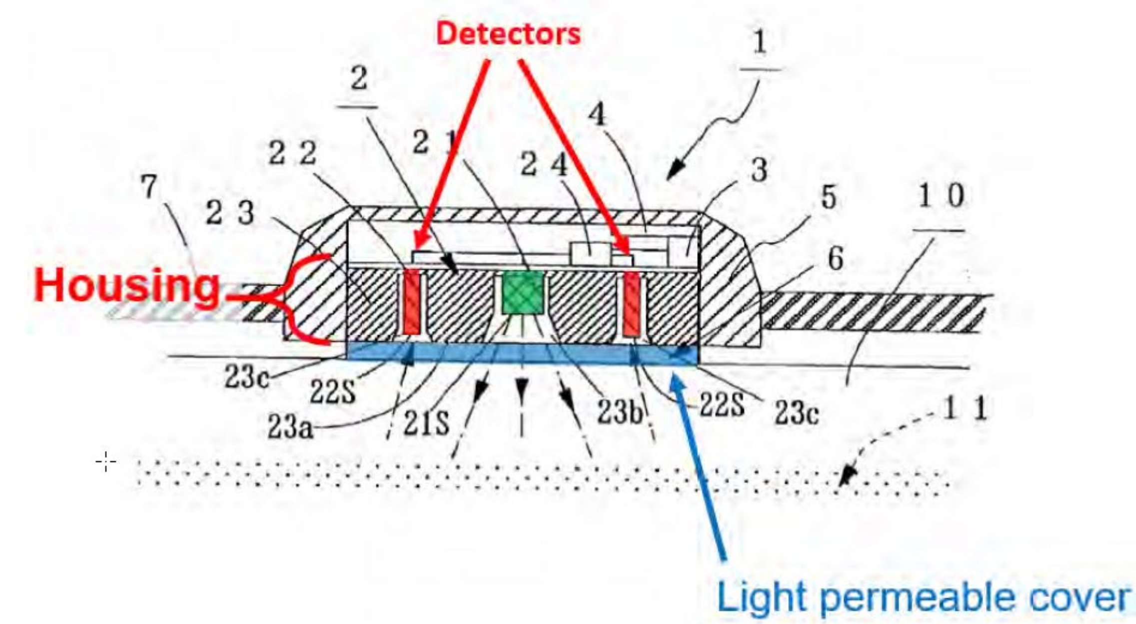
The cited evidence supports Petitioner's undisputed contention that Aizawa discloses at least four detectors 22 that are spaced apart on the surface, wherein the detectors output one or more signals indicative of a physiological parameter of the wearer, e.g., pulse, in response to light emitted by LED 21 that is attenuated by body tissue. Pet. 19–21; *see, e.g.*, Ex. 1006, Fig. 1(a) (depicting detectors 22 spaced apart around LED 21), ¶¶ 23 ("drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of the photodetectors 22"), 27 ("Near infrared radiation output toward the wrist 10 from the light emitting diode 21 is reflected by a red corpuscle running through the artery 11 of the wrist 10 and this reflected light is detected by the plurality of photodetectors 22 so as to detect a pulse wave."), 28 ("[T]he amplified output is converted into a digital signal for the computation of a pulse rate."); Ex. 1003 ¶¶ 77–79.

v. *"[d] a light permeable cover arranged above at least a portion of the housing, the light permeable cover comprising a protrusion arranged to cover the at least four detectors."*

<u>Petitioner's Contentions</u>

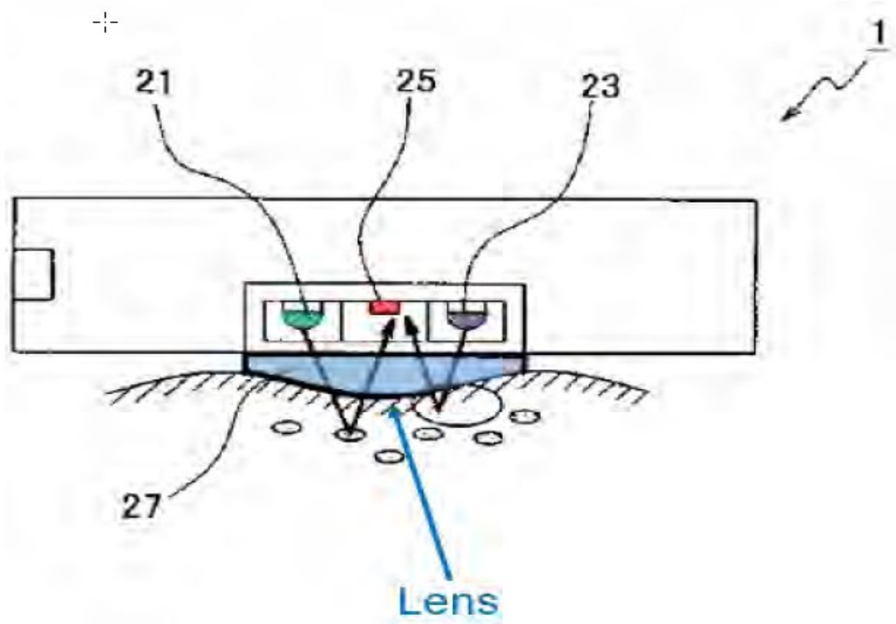
With reference to an annotated version of Aizawa's Figure 1(b) (reproduced below), Petitioner contends that "Aizawa teaches a light permeable cover in the form of an acrylic transparent plate 6 (blue) that is

mounted at the detection face 23a over at least a portion of the housing to cover the at least four detectors (red)." Pet. 22.



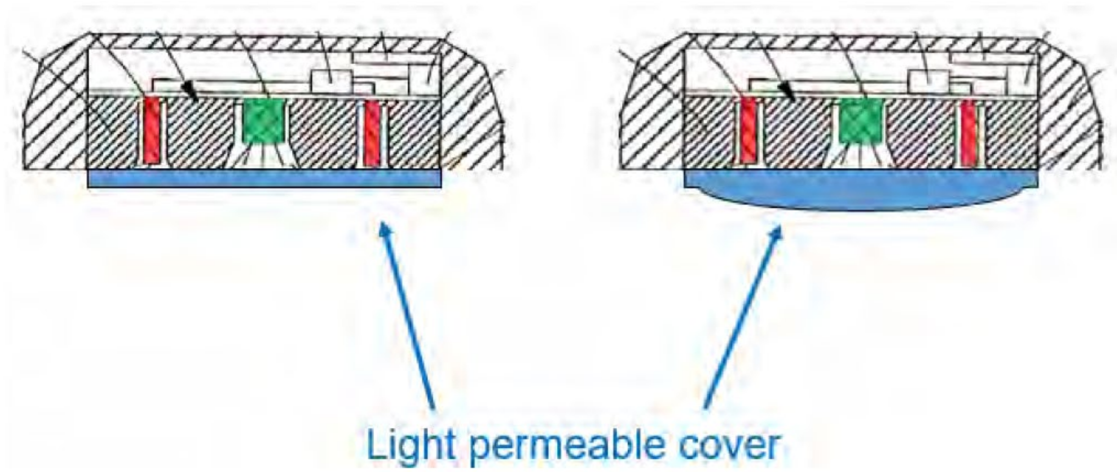
The figure above shows Petitioner's annotated version of Aizawa's Figure 1(b), in which transparent plate 6 is shaded in blue and identified as "Light permeable cover." Petitioner contends that beyond disclosing that the acrylic transparent "helps [to] improve 'detection efficiency,' Aizawa does not provide much other detail, for instance regarding its shape." *Id.* at 13 (citing Ex. 1006 ¶ 30).

Petitioner reasons, however, that one of ordinary skill in the art would have "looked to Inokawa to enhance light collection efficiency, specifically by modifying the light permeable cover of Aizawa to include a convex protrusion that acts as a lens." *Id.* at 14. In that regard, Petitioner points to Inokawa's Figure 2. Petitioner's annotated version of that figure is reproduced below.



Id. Figure 2 above depicts Inokawa's lens 27 shaded in blue. Petitioner expresses that "Inokawa teaches that its cover may be either flat . . . such that 'the surface is less prone to scratches'" or may be in the form of the lens shape shown above to "increase the light-gathering ability of the LED." *Id.* at 15 (quoting Ex. 1008 ¶ 15); *see* Ex. 1003 ¶¶ 83–87. Petitioner contends that a person of ordinary skill in the art "making the design choice to prioritize improved light collection efficiency over reduced suseptibility to scratches could have readily modified Aizawa's cover to include a lens as per Inokawa." Pet. 16 (citing Ex. 1003 ¶ 99). Petitioner also contends that a skilled artisan would have had a reasonable expectation of success in combining those teachings. *Id.* at 15 (citing Ex. 1003 ¶ 86). Petitioner adds that Aizawa's "transparent acrylic material . . . can be readily formed into a lens structure as in Inokawa." *Id.* at 16 (citing Ex. 1003 ¶ 87; Ex. 1009, 3:46–51, Fig. 1; Ex. 1023, Fig. 6, ¶¶ 22, 32, 35).

Petitioner provides annotated and modified versions of Aizawa's Figure 1(b) that depict the proposed combination, which are reproduced below. *Id.* at 15 (citing Ex. 1003 ¶ 85).



Petitioner's annotated figure on the left depicts Aizawa's device with its flat cover, and the annotated and modified figure on the right depicts the device resulting from the combination of Aizawa and Inokawa, in which a person of ordinary skill in the art would have replaced Aizawa's flat cover with a cover comprising a protrusion to "increase the light-gathering ability." *Id.* (quoting Ex. 1008 ¶ 15).

According to Petitioner, a person of ordinary skill in the art "would have understood how to implement Inokawa's lens in Aizawa's device with a reasonable expectation of success." Pet. 15–16 (citing Ex. 1008, Figs. 16, 17, ¶¶ 15, 106); Ex. 1003 ¶ 86. The shape of the modified cover in Dr. Kenny's illustration of the proposed modification above is similar to the shape of an LED lens illustrated in Exhibit 1023 (hereafter "Nishikawa"),[3] referenced by Petitioner and Dr. Kenny in connection with the proposed

[3] U.S. Patent Application Publication No. 2007/0145255 A1, filed Dec. 20, 2006, published June 28, 2007 (Ex. 1023).

ground of unpatentability. *Compare* Pet. 15 (illustrating proposed modification), *with* Ex. 1023, Fig. 6, ¶¶ 3, 22, 30, 32, 35 (illustrating lens 50 used with LED 22, and discussing how to make the illustrated device).

<u>Patent Owner's Arguments</u>

Patent Owner contends that the evidence does not support Petitioner's contention that it would have been obvious to modify Aizawa's cover to have a convex protrusion, in order to improve detection efficiency by directing incoming light to Aizawa's photodetectors 22, with a reasonable expectation of success. PO Resp. 12–37; PO Sur-reply 1–13; Ex. 2004 ¶¶ 48–78.

According to Patent Owner, the evidence establishes that Petitioner's proposed modification would direct light *toward the center* of Aizawa's detector 1 where emitter 21 is located, rather than *toward the periphery* where detectors 22 are located. PO Resp. 16–24; Ex. 2004 ¶¶ 50–65. Thus, Patent Owner's view is that a person of ordinary skill in the art "would ***not*** have expected Inokawa's protruding surface to accomplish" the objective of enhancing light collection efficiency relied upon by Petitioner, because Petitioner's proposed modification instead "would direct light ***away*** from the ***periphery***-located detectors" in Aizawa, the opposite result to Petitioner's contention. PO Resp. 20; Ex. 2004 ¶¶ 42–43, 48–57.

In support, Patent Owner points to Inokawa's Figure 2, in which two arrows illustrate light that passes through the convex protrusion of lens 27 toward the center of Inokawa's pulse sensor 1 where detector 25 is located. PO Resp. 14 (citing Ex. 1008 ¶ 58), 18; Ex. 2004 ¶¶ 42–43. Patent Owner also points to the '190 patent's Figure 14B, which illustrates several light rays 1420, 1422 passing through a partially cylindrical protrusion 605 to be

centrally focused on detector(s) 1410B. PO Resp. 19 (citing Ex. 1001, 35:67–36:2, 36:56–60; Ex. 2004 ¶¶ 53–55). Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, support Patent Owner's contentions in these regards. *See* PO Resp. 2, 17–18 (citing Ex. 2006, 83:15–84:2, 86:19–87:1, 202:11–204:20).

Patent Owner also asserts that "Dr. Kenny admitted that the impact of Inokawa's convex lens would not be 'obvious' in the context of [the] different configuration of LEDs and detectors" presented by Aizawa. PO Resp. 20–21 (citing Ex. 2006, 87:2–6). For example, Patent Owner points out that "light reaching Aizawa's detectors must travel in an opposite direction from the light in Inokawa." *Id.* at 21–22 (citing Ex. 1006, Fig. 1(b); Ex. 1008, Fig. 2); Ex. 2004 ¶¶ 61–64. In addition, according to Patent Owner, "Petitioner's combination is particularly problematic because" Aizawa uses "small detectors [22] with small openings [of cavities 23c] surrounded by a ***large*** amount of ***opaque*** material." PO Resp. 22 (citing Ex. 1006, Fig. 1(a)); Ex. 2004 ¶ 63. In support of its view, Patent Owner cites portions of Dr. Kenny's deposition testimony. *See* PO Resp. 22 (citing Ex. 2006, 257:11–18).

Patent Owner further argues that Dr. Kenny, during his deposition, attempted to evade the foregoing problems by "disclaim[ing] Petitioner's reasoning [for obviousness] and assert[ing] new and improper opinions" that undermine the reasoning provided in the Petition. PO Resp. 24. For example, Patent Owner asserts that Dr. Kenny's attempt to distinguish between the '190 patent's Figure 14B as illustrating a lens that condenses *collimated* light toward the center, as compared to Aizawa and Inokawa in which the lens focuses *diffuse* light reflected by the user's body is not

persuasive and is not supported by record evidence. PO Resp. 25–26 (citing Ex. 2006, 170:9–171:5; Ex. 2007, 288:13–289:5, 294:17–298:10, 298:11–299:18, 423:7–424:18); Ex. 2004 ¶¶ 67–68. Patent Owner also objects to Dr. Kenny's testimony that, "while a protruding surface would generally direct more light to the center," it "would also capture some light that otherwise would not be captured" by Aizawa's detectors 22, as lacking evidentiary support and relying on impermissible hindsight. PO Resp. 26–27 (citing Ex. 1001, 7:61–63; Ex. 2004 ¶¶ 69–70; Ex. 2006, 204:21–206:5, 206:22–208:1; Ex. 2007, 294:17–298:10).

Patent Owner moreover asserts that "Dr. Kenny repeatedly distanced himself from his own similar combination" of Aizawa and Inokawa by refusing to talk about the specific shape, size, material, and dimensional tolerances of the combination, so, in Patent Owner's view, his testimony falls short because it demonstrates at most only that the references could have been combined. *Id.* at 2–3, 27–31 (citing, e.g., Ex. 2004 ¶¶ 71–73; Ex. 2006, 51:14–52:16, 75:20–77:2, 91:9–92:13, 96:20–21, 97:11–21, 100:17–101:18, 132:10–18, 154:4–7, 164:8–16, 189:11–190:3; Ex. 2007, 308:12–309:8, 310:18–311:9, 318:3–6, 324:21–325:19, 333:20–335:4).

Indeed, according to Patent Owner, because ordinary skill does not require specific education or experience with optics or optical physiological monitors (*see supra* Section II.C), "[i]t strains credibility that a [person of ordinary skill in the art] . . . could balance all of the factors Dr. Kenny identified" to reach the claimed invention. PO Resp. 32. Patent Owner relies on Dr. Kenny's testimony as establishing the complexity of designing optical physiological sensors. *Id.* at 3–4, 32–33 (citing Ex. 2006, 86:19–87:6; Ex. 2007, 331:19–332:11, 336:11–337:15). Patent Owner concludes

Petitioner has failed to establish a reasonable expectation of success because Dr. Kenny's testimony "focuses almost entirely on manufacturing." *Id.* at 33 (citing Ex. 1003 ¶ 87; Ex. 2004 ¶ 75).

Patent Owner moreover asserts Petitioner errs in relying on Nishikawa as supporting the unpatentability of claim 1, because Nishikawa is "not identified as part of" the ground, which instead "includes only two references," Aizawa and Inokawa. PO Resp. 34 (citing Pet. 1, 13–14; Ex. 1003 ¶¶ 82–87); *id.* at 35–36 (citing 35 U.S.C. § 312(a)(3); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)). Patent Owner asserts Dr. Kenny "relies heavily" on Nishikawa, particularly "to inform the specific shape of the cover in his combination, which is found nowhere in Aizawa and Inokawa." *Id.* at 34–35 (citing Pet. 23; Ex. 2004 ¶¶ 76–77; Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12).

Furthermore, in Patent Owner's view, Dr. Kenny's reliance on Nishikawa "make[s] no sense" because "Nishikawa's device is not a physiological sensor" but rather is "an encapsulated LED" that "directs ***outgoing*** light through the encapsulation material and thus focuses on the emission of light, not the detection of an optical signal." PO Resp. 36 (citing Ex. 1023, code (57), ¶¶ 3, 32, 35; Ex. 2004 ¶ 78). Patent Owner contrasts such disclosure with Aizawa and Inokawa, both of which "detect[] ***incoming*** light that passes through the cover and reaches the detectors," and which have a "drastically" smaller scale than Nishikawa's LEDs. *Id.* (citing Ex. 1008, Fig. 2; Ex. 2004 ¶ 78).

Petitioner's Reply

In reply, Petitioner insists "Inokawa's lens enhances the light-gathering ability of Aizawa," which would have motivated an ordinarily skilled artisan "to incorporate 'an Inokawa-like lens [having a protrusion] into the cover of Aizawa to increase the light collection efficiency.'" Pet. Reply 2–3 (bolding omitted) (citing Pet. 13–15; Ex. 1003 ¶¶ 80–87; Ex. 1008, Fig. 2, ¶¶ 15, 58). Petitioner dismisses Patent Owner's and Dr. Madisetti's opposition as being "misinformed" because a person of ordinary skill in the art "would understand that Inokawa's lens generally improves 'light concentration at pretty much all of the locations under the curvature of the lens,' as opposed to only at a single point at the center." *Id.* at 3–4 (quoting Ex. 2006, 164:8–16); Ex. 1047 ¶¶ 7–9.

For example, Petitioner contends that Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility," by which "a ray going from P to S will trace the same route as one from S to P." Pet. Reply 4 (underlining omitted) (citing, e.g., Ex. 1052,[4] 84, 87–92); Ex. 1047 ¶¶ 10–22. Petitioner contends that Dr. Madisetti was evasive when he was asked to apply the reversibility principle to the combination of Aizawa and Inokawa in this case. Pet. Reply 6 (citing Ex. 1034, 89:12–19, 84:2–85:7). Petitioner further contends that, "based at least on the principle of reversibility," one of ordinary skill in the art "would have understood that both configurations of LEDs and detectors—i.e., with the LED at the center as in Aizawa or with

[4] Eugene Hecht, *Optics* (2nd ed. 1990). In referring to Exhibit 1052, Petitioner refers to the document's native page numbering (top corner of each page) and not the added page numbering of the exhibit (bottom, middle of each page). For consistency, we also refer to the native page numbering of Exhibit 1052.

the detector at the center as in Inokawa—would similarly benefit from the enhanced light-gathering ability of an Inokawa-like lens." *Id.* at 9 (citing Ex. 1047 ¶ 22).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue in the user's wrist, to be received by detectors in either Aizawa's or Inokawa's pulse sensor, will be "scattered" and "diffuse" and, therefore, will approach the detectors "from various random directions and angles." Pet. Reply 9–10, 13 (annotating Inokawa's Fig. 2 to illustrate the cause and nature of the back-scattering); Ex. 1047 ¶¶ 23–26. This scattered and diffuse light, according to Petitioner, means that Inokawa's "lens cannot focus all light toward the sensor's center," as Patent Owner would have it. Pet. Reply 9 (citing Ex. 1047 ¶ 23; Ex. 2006, 163:12–164:2). Petitioner asserts this is due to Snell's law, and provides several illustrations to illustrate why. *Id.* at 9–15 (citing, e.g., Ex. 1047 ¶¶ 23–34).

Due to the random nature of this scattered light, Petitioner explains that one of ordinary skill in the art would have understood that a convex cover "provides a slight refracting effect, such that light rays that may have missed the detection area are instead directed toward that area." Pet. Reply 10 (citing Ex. 1047 ¶¶ 25–26). Petitioner applies this understanding to Aizawa, and contends that using a lens with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source. *Id.*

Moreover, Petitioner dismisses the applicability of Figure 14B of the '190 patent as illustrating the operation of a *transmittance*-type of sensor that measures the attenuation of collimated light transmitted through the

user's body tissue, rather than the *reflectance*-type sensor of Aizawa. *Id*. at 11–13 (citing, e.g., Ex. 1001, 35:65–67; Ex. 1047 ¶¶ 27–31).

Petitioner further maintains that illustrations of the light-focusing properties of a convex lens discussed in the Petition filed in IPR2020-01520 (Ex. 2019, 39) and relied upon by Dr. Kenny (Ex. 2020, 119–120) do not demonstrate "that a convex lens directs all light to the center." Pet. Reply 15 (citing PO Resp. 16–18, 23). Petitioner contends these illustrations, instead, "are merely simplified diagrams included to illustrate . . . one example scenario (based on just one ray and one corpuscle) where a light permeable cover can 'reduce a mean path length of light traveling to the at least four detectors'" as recited in claim 12 of the patent challenged in that proceeding. *Id.* (citing, e.g., Ex. 1047 ¶ 34).

Patent Owner's Sur-reply

Patent Owner asserts that Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *See, e.g.*, PO Sur-reply 1 ("new optics theories" and "new arguments"), 2, 6, 7, 9, 10, 12, 13.

Patent Owner also contends that Petitioner mischaracterizes Patent Owner's position, which is not that Inokawa's lens with a convex protrusion "would direct '***all***' light 'only at a ***single point*** at the center'" of the sensor. *Id.* at 2, n.2 (quoting Pet. Reply 3; citing, e.g., Ex. 2027, 63:7–64:6, 94:20–96:1, 96:18–97:7). Patent Owner's position, rather, is that Inokawa's lens condenses more light (not necessarily all light) "***towards the center*** of the sensor" as compared to a flat surface. *Id.* at 2 (quoting PO Resp. 19; citing, e.g., Ex. 2004 ¶¶ 34, 43, 49, 51–52, 54–55, 67).

Patent Owner moreover asserts "[t]here can be no legitimate dispute that a convex surface directs light centrally (and away from the periphery)." PO Sur-reply 3–6 (citing PO Resp. 15–18; Ex. 2006, 164:8–16, 166:10–17, 170:22–171:5; Ex. 2020 ¶¶ 119, 200; Ex. 2027, 181:9–182:5). Patent Owner contends that Petitioner's argument "that Inokawa would improve light-gathering at all locations, ***regardless*** of the location of the LEDs and detectors" is belied by Dr. Kenny's testimony that "Inokawa's benefit would ***not*** be clear if Inokawa's LEDs and detectors were moved" and "confirmed that a convex surface would direct light toward the center of the underlying sensor." *Id.* at 6 (citing Pet. Reply 3–4; Ex. 2006, 86:19–87:6, 202:11–204:20).

Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes ideal conditions that are not present when tissue scatters and absorbs light." PO Sur-reply 6–8 (citing Ex. 2027, 17:12–19:2, 29:11–30:7, 31:8–32:3, 38:17–42:6, 207:9–209:21, 210:8–6). The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether a convex surface—***as compared with a flat surface***—would collect and focus additional light on Aizawa's peripherally located detectors." *Id.* at 8–9 (citing Ex. 2027, 212:3–14).

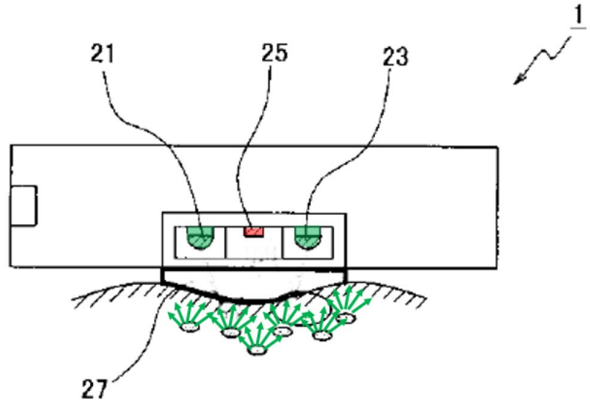
Patent Owner also argues that Petitioner's position that a convex cover will provide a "***slight***" refracting effect, "directly undermines Petitioner's provided ***motivation*** to combine," i.e., to enhance light collection efficiency. *Id.* at 10–11.

Analysis

Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's view that it would have been obvious to modify Aizawa's cover 6 to include a convex lens or protrusion like that taught in Inokawa, in order to increase the amount of backscattered light that will be received by Aizawa's four peripheral detectors 22, as compared with Aizawa's existing flat cover.

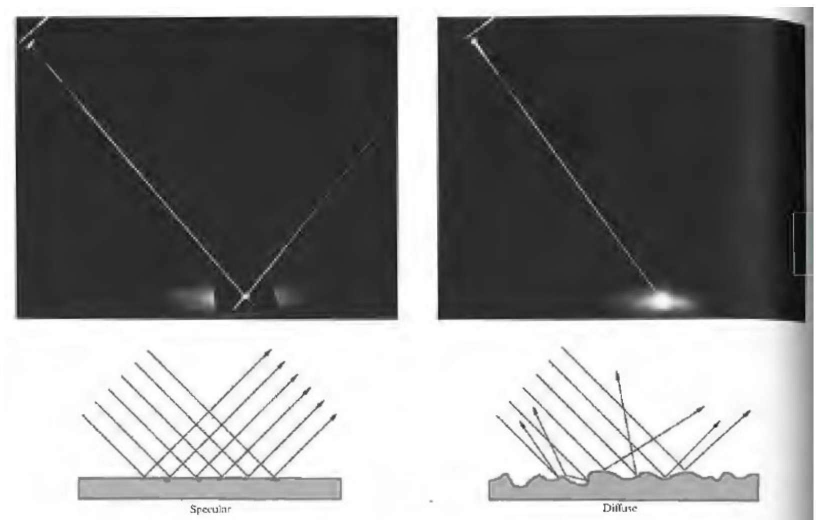
Aizawa's and Inokawa's pulse sensors both gather data by emitting light into the user's wrist tissue and collecting the light that reflects back to the sensor from the user's tissue. *See, e.g.*, Ex. 1006, Figs. 1(b), 2 (sensor 2 has emitter 21 and four detectors 22, all facing a user's wrist 10); Ex. 1008, Figs. 1, 2 (sensor 1 has two emitters 21, 23 and one detector (photodiode 25), all facing the user's wrist when held in place by wristband 5). Dr. Kenny testifies, and Patent Owner agrees, that the reflection of this light by the user's wrist tissue randomizes the propagation direction of the reflected light rays. *See* Ex. 1003 ¶ 117; Ex. 1047 ¶¶ 14–15; Ex. 2020 ¶ 128; PO Sur-reply 7–8 ("Even Petitioner admits that tissue randomly scatters and absorbs light rays.").

This reflection principle is illustrated by Dr. Kenny's annotations to Inokawa's Figure 2 reproduced below:



Here, Dr. Kenny has modified Inokawa's Figure 2 by (1) removing two black arrows, (2) coloring Inokawa's light detector in red and Inokawa's two light emitters in green, and (3) adding several green arrows to illustrate the various directions that light rays may be directed after impinging on and reflecting off different tissues in the user's wrist. Ex. 1047 ¶ 32.

This randomized direction of reflected light rays results in backscattered light that is diffuse, rather than collimated, in nature. Figure 4.12 of Exhibit 1052 illustrates the difference between diffuse and collimated light, and is reproduced below:

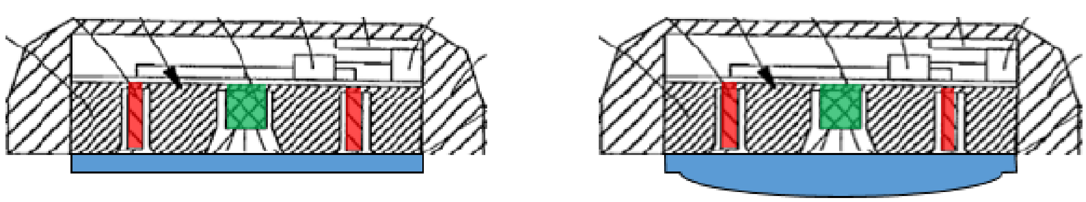


This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1052, 87–88. The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* By contrast, the rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*

This diffuse nature of the light reflected from the user's wrist tissue, which both Aizawa and Inokawa aim to collect to generate pulse data,

suggests that a lens might be useful to increase the amount of collected light and thereby increase the reliability of the pulse data generated using the collected light. Indeed, that is taught by Inokawa. Inokawa describes using its lens 27 to "increase the light-gathering ability" of Inokawa's light photodiode or detector 25.[5] Ex. 1008 ¶¶ 15, 58. Furthermore, there is also no dispute that Inokawa's lens 27 is understood to be shaped as a convex protrusion. *See, e.g.*, Ex. 1003 ¶¶ 83–84 (characterizing Inokawa as teachings a "convex protrusion that acts as a lens"); PO Resp. 1 (describing Inokawa as teaching a "convex lens"). Thus, Inokawa demonstrates that it was known in the art to use a lens comprising a protrusion to focus diffuse light reflected from body tissue on to the light detecting elements of a wrist-worn pulse sensor, and to increase the light gathered by the sensor thereby improving the device's calculation of the user's pulse.

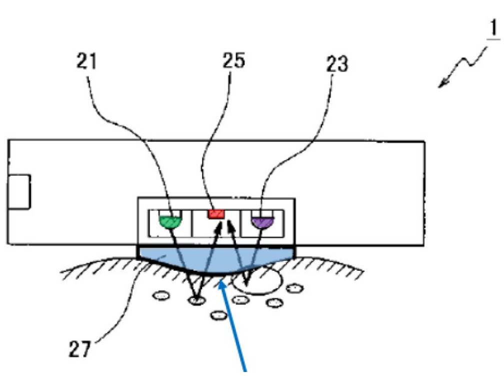
A preponderance of the evidence supports Petitioner's view that it would have been obvious for a person of ordinary skill in the art to apply Inokawa's lens technology to Aizawa's wrist-worn pulse sensor, to similarly improve its light collection as compared to Aizawa's existing flat cover. That is depicted in the following illustrations provided by Dr. Kenny:

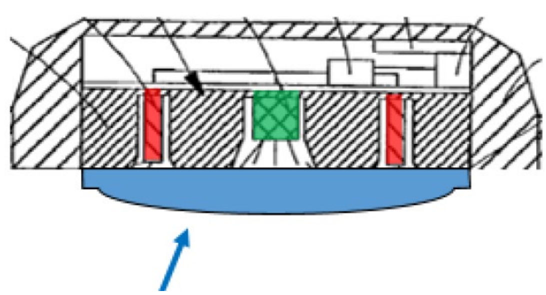


[5] Although Inokawa refers to the "LED" such as emitters 21, 23 in that regard (Ex. 1008 ¶ 15), rather than photodiode 25, it is undisputed that photodiode 25 is the only component of Inokawa's sensor 1 that gathers light.

The illustration at left modifies Aizawa's Figure 1(b) to color Aizawa's emitter in green, its detectors in red, and Aizawa's existing flat cover in blue; the illustration on the right includes Aizawa's Figure 1(b) with the same coloring, but wherein the flat cover is modified to incorporate a convex protrusion that covers Aizawa's peripheral light detectors and central light emitter. *See* Ex. 1003 ¶ 85. We are persuaded by Dr. Kenny's testimony that Snell's law indicates that "light rays that may have otherwise missed the detection area are instead directed toward that area as they pass through the interface provided by the cover," and is especially true "in configurations like Aizawa's in which light detectors are arranged symmetrically about a central light source, so as to enable backscattered light to be detected within a circular active detection area surrounding that source." Ex. 1049 ¶ 26; *see also id.* ¶¶ 23–26.

Patent Owner correctly notes that Inokawa's single detector 25 is located in the central portion of Inokawa's sensor 1, whereas Aizawa's four detectors 22 are located towards the periphery of Aizawa's sensor 2. *Compare* Ex. 1008, Fig. 2, *with* Ex. 1006, Figs. 1(a)–1(b). Nevertheless, Petitioner's proposed modification of Aizawa takes that arrangement into account, as can be seen by the following comparison between Inokawa's sensor and Petitioner's proposed modification of Aizawa's sensor:





The illustration at left annotates Inokawa's Figure 2 to identify the central detector in red and the lens in blue (*see* Ex. 1003 ¶ 83), and the illustration at right annotates Petitioner's proposed modification of Aizawa to illustrate the peripheral detectors in red and the lens in blue (*see id.* ¶ 85). As can be seen, the lenses are not identical. In Inokawa the lens's curvature is most pronounced at the center of the lens near the central detector, and in the proposed modification to Aizawa, the lens's curvature is most pronounced at the edges of the lens near the peripheral detectors. Thus, Dr. Kenny's proposed modification of Aizawa takes Inokawa's general teaching of using a convex protruding lens to increase the amount of incoming light directed to a light detector, and applies it to the four light detectors of Aizawa. *See, e.g.*, Ex. 1003 ¶ 85 ("POSITA would have found it obvious to make the protrusion portion of the LPC [light permeable cover]—namely the lens-shaped light-gathering portion—to ensure that the light-concentration effect achieved by the lens impacts all of the detectors."); *id.* ¶¶ 84–87; Ex. 1047 ¶¶ 7–34.

We are cognizant of Patent Owner's contention that Petitioner's ground "improperly" relies upon a reference, Nishikawa, that was not identified as a part of the ground of unpatentability. PO Resp. 34. As Patent Owner observes, Dr. Kenny characterizes his testimony as being "***inspired*** by" or "motivated" in part based on Nishikawa's disclosure when it comes to the shape of a convex lens. *See, e.g.*, PO Resp. 35–37 (citing, e.g., Ex. 2007, 364:2–13; Ex. 2008, 73:8–12). We, however, disagree with Patent Owner that any impropriety arises from Dr. Kenny's contemplation of the teachings of Nishikawa in connection with the shape of a lens for a physiological sensor. The nature of Petitioner's and Dr. Kenny's

consideration of Nishikawa is explained in cited portions of Dr. Kenny's declaration, even if Nishikawa is not listed as a third reference in the identification of the ground. *See* Ex. 1003 ¶ 87 ("[M]any prior art references of this period, such as Nishikawa (shown below) demonstrate exactly how such a lens shape [as taught by Inokawa] may be incorporated into a molded cover."); Pet. 16. Indeed, it follows readily from the Petition that a skilled artisan would have appreciated that Nishikawa's teachings provide insight as to how "the transparent acrylic material used to make Aizawa's plate can be readily formed into a lens structure as in Inokawa." Pet. 16. Nishikawa describes how its "lens unit 50" can be a transparent resin formed in the shape illustrated in Figure 6 by injection molding. Ex. 1023 ¶¶ 22, 32, 35. Dr. Kenny also explains that Nishikawa's lens shape design "is intended to provide curvature in the lens where it can do the most good and otherwise try to avoid excess use of material in order to create curvature in locations where it wouldn't do any good." Ex. 2006, 179:21–180:13.

Moreover, we observe that a rejection based on obviousness "require[s] an analysis that reads the prior art in context, taking account of 'demands known to the design community,' 'the background knowledge possessed by a person having ordinary skill in the art,' and 'the inferences and creative steps that a person of ordinary skill in the art would employ.'" *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (quoting *KSR*, 550 U.S. at 418). Furthermore, record evidence can be useful to "demonstrate the knowledge and perspective one of ordinary skill in the art." *Id.*; *see also Ariosa Diagnostics v. Verinata Health Inc.*, 805 F.3d 1359, 1365 (Fed. Cir. 2015) ("Art can legitimately serve to document the

knowledge that skill artisan would bring to bear in reading the prior art identified as producing obviousness.”).

As noted above, Dr. Kenny makes clear that his view as to obviousness of the claims of the ’190 patent was “inspired by” or “motivated” in part by Nishikawa’s teachings as to shapes generally known to those in the art of manufacturing a lens. *See, e.g.*, Ex. 2007, 364:2–13; Ex. 2008, 73:12–21. We conclude that the record establishes that Nishikawa’s teachings are representative of background knowledge of one of ordinary skill in the art and provide context and perspective of a skilled artisan as to the type of shapes available for a convex protruding surface, such as that disclosed in Inokawa. That Dr. Kenny considered record evidence cited in the Petition as informing his view of what a skilled artisan would understand as to known types of lens shapes does not establish, in our view, any impropriety as part of that ground.

Patent Owner additionally asserts, and Dr. Madisetti testifies, that Petitioner’s combination of Aizawa and Inokawa is “problematic” because it overlooks the “small” size of Aizawa’s detectors 22 and the openings or cavities 23c in which they are housed. *See* PO Resp. 22 (citing Ex. 1006, Fig. 1(a); Ex. 2004 ¶ 63). Patent Owner, however, does not articulate what significance the size of Aizawa’s detector components have in the obviousness evaluation based on the teachings of the prior art.

We additionally do not agree with Patent Owner’s argument that Petitioner’s Reply presents new arguments and evidence that should have been first presented in the Petition. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa’s device. *See,*

e.g., Pet. 13–16. Patent Owner, in its Response, challenged that contention with several arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleged. *See, e.g.*, PO Resp. 16–37. In its Reply, Petitioner provided arguments and evidence attempting to rebut the contentions made in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019)[6], 73 ("A party also may submit rebuttal evidence in support of its reply."). The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 13–16, *with* Pet. Reply 2–15.

Patent Owner finally argues that a conclusion of obviousness "strains credibility" because the level of ordinary skill in the art (*see supra* Section II.C) does not require specific education or experience with optics or optical physiological monitors. *See, e.g.*, PO Resp. 32. We disagree. Concerning motivation, the record demonstrates that an ordinarily skilled artisan would have readily appreciated that: (1) Aizawa's detector 1 operates by gathering light with its photodetectors 22; (2) a lens was known to focus light on photodetectors; and (3) optical lenses may be formed by providing a convex protrusion in the lens to focus light. Indeed, Inokawa discloses such utility, function, and structure as a part of its convex lens. *See, e.g.*, Ex. 1008 ¶¶ 15, 58, Fig. 2. We are persuaded that a person of ordinary skill in the art would have understood these general concepts of optics.

Concerning reasonable expectation of success, we credit Dr. Kenny's testimony that a person of ordinary skill in the art would have understood

---

[6] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

that by "positioning a lens above the optical components of Aizawa . . . the modified cover will allow more light to be gathered and refracted toward the light receiving cavities of Aizawa, thereby further increasing the light-gathering ability of Aizawa beyond what is achieved through the tapered cavities," and "would have found it obvious to make the protrusion portion of the LPC—namely the lens-shaped light-gathering portion—to ensure that the light-concentration effect achieved by the lens impacts all of the detectors." *See, e.g.*, Ex. 1003 ¶ 85; Ex. 2006, 179:21–180:13, 202:11–20.

Thus, we conclude that one of ordinary skill in the art would have had adequate reason to replace Aizawa's flat cover 6 with a cover comprising a convex protrusion, to improve light detection efficiency, and would have had a reasonable expectation of success in doing so.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

4. Independent Claim 26

Independent claim 26 consists of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:37–53, *with id.* at 46:22–40 (reciting a "circular housing" with a "wall"; reciting a "lens portion"). In asserting that claim 26 would have been obvious over the combined teachings of Aizawa and Inokawa, Petitioner refers to substantially the same contentions presented as to claim 1. *See* Pet. 39–41; Ex. 1003 ¶¶ 119–124.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 12–41.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 26 would have been obvious over the cited combination of references. *See supra* II.D.3.i–v; Ex. 1003 ¶¶ 119–124.

5. Dependent Claims 2–14, 16, 17, 19–23, and 27–29

i. Dependent Claim 5

Petitioner identifies dependent claim 5 as being challenged in its proposed ground of unpatentability based on Aizawa and Inokawa. *See* Pet. 1 (listing claims 1–14, 16, 17, 19–23, 26–29 as part of this ground), 8 (heading identifying the same challenged claims). But, Petitioner does not present any contentions addressing the specific limitations of claim 5. *See id.* at 23–42 (purportedly addressing all challenged claims beyond claim 1, but failing to discuss claim 5). As such, Petitioner has not met its burden.

ii. Dependent Claims 2–4, 6–14, 16, 17, 19–23, and 27–29

Petitioner presents undisputed contentions that claims 2–4, 6–14, 16, 17, 19–23, and 27–29, which depend directly or indirectly from independent claim 1 or 26, are unpatentable over the combined teachings of Aizawa and Inokawa, and provides arguments explaining how the references teach the limitations of these claims. Pet. 23–39, 41–42; Ex. 1003 ¶¶ 88–118, 125–127.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 41 ("The Petition fails to establish that independent claims 1 and 26 are obvious and thus fails to establish any of the challenged dependent claims are obvious.").

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–4, 6–14, 16, 17, 19–23, and 27–29 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

E. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Mendelson-2006

Petitioner contends that claims 23 and 24 are unpatentable based on Aizawa, Inokawa, and Mendelson-2006. Pet. 45–50. Claim 23 depends from claim 1 and recites, "[t]he noninvasive optical physiological measurement device is comprised as part of a mobile monitoring device." Ex. 1001, 46:8–11. Claim 24 depends from claim 23 and further recites, "the mobile monitoring device includes a touch-screen display." *Id.* at 46:12–14.

1. Mendelson-2006 (Ex. 1016)

Mendelson-2006 is a journal article titled "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring," and discloses a

wireless wearable pulse oximeter connected to a personal digital assistant ("PDA"). Ex. 1016, 912.[7]

Figure 1 of Mendelson-2006 is reproduced below.

Figure 1, at top, illustrates a sensor module attached to the skin and, at bottom, presents a photograph of a disassembled sensor module and receiver module. The sensor module includes an optical transducer, a stack of round printed circuit boards, and a coin cell battery. *Id.* at 2.

[7] Petitioner cites to the native page numbering within Exhibit 1016. *See, e.g.*, Pet. 45–50. We follow Petitioner's numbering scheme.

Figure 2 of Mendelson-2006 is reproduced below.

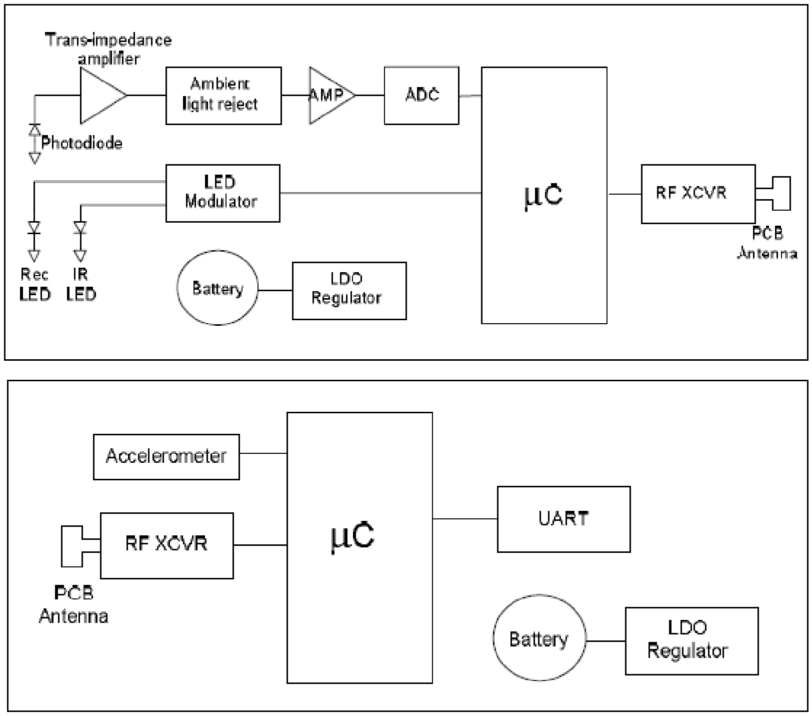


Figure 2 depicts a system block diagram of the wearable, wireless, pulse oximeter including the sensor module, at top, and the receiver module, at bottom. *Id.* The sensor module includes at least one LED, a photodetector, signal processing circuitry, an embedded microcontroller, and an RF transceiver. *Id.* at 1–2. Mendelson-2006 discloses that a concentric array of discrete photodetectors could be used to increase the amount of backscattered light detected by a reflectance type pulse oximeter sensor. *Id.* at 4. The receiver module includes an embedded microcontroller, an RF transceiver for communicating with the sensor module, and a wireless module for communicating with the PDA. *Id.* at 2.

As a PDA for use with the system, Mendelson-2006 discloses "the HP iPAQ h4150 PDA because it can support both 802.11b and Bluetooth™ wireless communication" and "has sufficient computational resources." *Id.* at 3. Mendelson-2006 further discloses that

> [t]he use of a PDA as a local terminal also provides a low-cost touch screen interface. The user-friendly touch screen of the PDA offers additional flexibility. It enables multiple controls to occupy the same physical space and the controls appear only when needed. Additionally, a touch screen reduces development cost and time, because no external hardware is required. . . . The PDA can also serve to temporarily store vital medical information received from the wearable unit.

Id.

The PDA is shown in Figure 3 of Mendelson-2006, reproduced below.

Figure 3 illustrates a sample PDA and its graphical user interface ("GUI"). *Id.* Mendelson-2006 explains that the GUI allows the user to interact with the wearable system. *Id.* "The GUI was configured to present the input and output information to the user and allows easy activation of various functions." *Id.* "The GUI also displays the subject's vital signs, activity level, body orientation, and a scrollable PPG waveform that is transmitted by the wearable device." *Id.* For example, the GUI displays numerical oxygen saturation ("SpO_2") and heart rate ("HR") values. *Id.*

2. Analysis

With support from the testimony of Dr. Kenny, Petitioner contends that claims 23 and 24 are unpatentable based on Aizawa, Inokawa, and Mendelson-2006. Pet. 45–50 (citing Ex. 1003 ¶¶ 69–71, 133–136; Ex. 1006 ¶¶ 2, 15, 23, 35; Ex. 1008 ¶ 56; Ex. 1016, 912–914, Figs. 1, 3; Ex. 1022). For instance, Petitioner applies the teachings of Mendelson-2006 to account for the mobile monitoring device features required by claim 23 and the touch-screen display recited in claim 24. *Id.*

Patent Owner does not separately address this ground, urging only that the ground "do[es] not fix the deficiencies" alleged in connection with the ground based on Aizawa and Inokawa. PO Resp. 41. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.D.

We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claims 23 and 24 are unpatentable based on Aizawa, Inokawa, and Mendelson-2006.

F. Obviousness over the Combined Teachings of Aizawa, Inokawa, Mendelson-2006, and Beyer

Petitioner contends that claim 25 is unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer. Pet. 56–60. Claim 25 depends from claim 1 and recites, "a processor configured to receive the one or more signals and communicate physiological measurement information to a mobile phone." Ex. 1001, 46:15–21.

1. Overview of Beyer (Ex. 1019)

Beyer is a U.S. patent titled "Cellular Phone/PDA Communication System," and discloses a "cellular PDA communication system for allowing a plurality of cellular phone users to monitor each others' location and status[and] to initiate cellular phone calls." Ex. 1019, code (57). Beyer's Figure 1 is reproduced below.

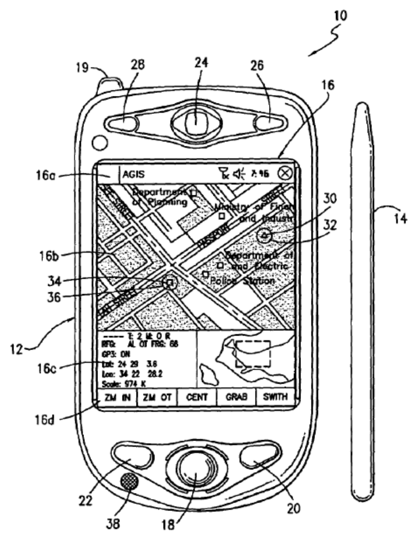


FIG. 1

Figure 1 depicts a "cellular phone/PDA and display." *Id.* at 7:8–9.

2. Analysis

With support from the testimony of Dr. Kenny, Petitioner contends that claim 25 is unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer. Pet. 56–60 (citing, e.g., Ex. 1003 ¶¶ 150–156; Ex. 1016, 913–914; Ex. 1019, 1:6–15, Fig. 1). For instance, Petitioner applies the teachings of Beyer to account for the processor features required by claim 25. *Id.*

Patent Owner does not separately address this ground, urging only that the ground "do[es] not fix the deficiencies" alleged in connection with the ground based on Aizawa and Inokawa. PO Resp. 41. As discussed

above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.D.

We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claim 25 is unpatentable based on Aizawa, Inokawa, Mendelson-2006, and Beyer.

G. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Al-Ali

Petitioner contends that claim 5 is unpatentable over Aizawa, Inokawa, and Al-Ali. Pet. 60–62. Dependent claim 5 ultimately depends from independent claim 1 and recites that "the light permeable cover comprises a conductive layer configured to shield the at least four detectors from noise." Ex. 1001, 44:64–67.

1. Overview of Al-Ali (Ex. 1030)

Al-Ali is a U.S. patent application publication titled "Multiple Wavelength Optical Sensor." Ex. 1030, code (54). Al-Ali discloses an optical sensor with an emitter that radiates light into a tissue site to be received by a detector such that, e.g., oxygen saturation may be derived. *Id.* at code (57). Al-Ali describes detector 1900 having shield 1910 with conductive surface 1920 defining windows, shown below in Figure 19A-B. *Id.* ¶ 71.

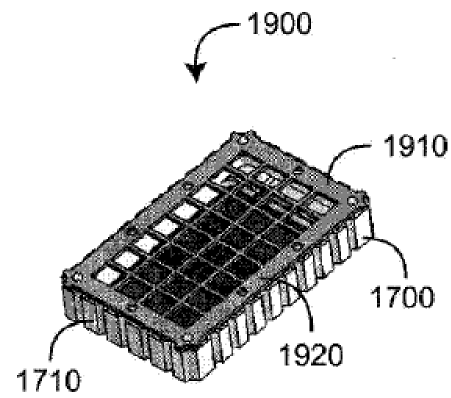


FIG. 19A

Figure 19A depicts a top view of a detector. Al-Ali explains that light is permitted to pass through the windows, while other electromagnetic noise is blocked. *Id*. Al-Ali explains that additional shielding material also can be applied to the ceramic substrate 1710. *Id.*

2. *Analysis*

Petitioner contends that "Al-Ali teaches shielding the detectors of a pulse oximeter/optical sensor by placing a conductive shield 1920 above the housing, thereby providing a Faraday cage that can allow 'passage of light' to the detectors while 'blocking . . . electromagnetic noise.'" *Id.* at 60 (citing Ex. 1030 ¶ 71, Fig. 19A; Ex. 1003 ¶ 156-A). Petitioner asserts this "improve[s] the sensitivity of the detectors, thereby leading to more reliable pulse/signal detection." *Id.* at 61.

According to Petitioner, a person of ordinary skill in the art "would have found it obvious to add a similar conductive shield/layer between the detectors and the LPC to prevent electromagnetic noise from reaching the detectors while still allowing desired signals/wavelengths to pass through, thereby reducing the effects of noise and resulting in improved light

collection efficiency." *Id.* (citing Ex. 1003 ¶ 156-B). Petitioner contends that this "entails the use of known solutions to improve similar systems and methods in the same way," and "would have led to [the] predictable result of reducing noise and improving signal collection without significantly altering or hindering the functions performed by Aizawa." *Id.* at 62 (citing Ex. 1003 ¶ 156-C).

Patent Owner does not separately address this ground, urging only that the ground "do[es] not fix the deficiencies" alleged in connection with the ground based on Aizawa and Inokawa. PO Resp. 41. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.D.

We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claim 5 is unpatentable based on Aizawa, Inokawa, and Al-Ali. Specifically, Al-Ali teaches the use of a conductive material to eliminate noise. Ex. 1030 ¶ 71. In light of this teaching, we credit Dr. Kenny's unrebutted testimony that a person of ordinary skill in the art would have found it obvious to implement such a conductive material in the sensor of Aizawa and Inokawa to reduce noise, as was well-known in the art. Ex. 1003 ¶¶ 156-A, 156-B.

H. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Ohsaki

Petitioner contends that claims 1–14, 16, 17, 19–23, and 26–29 are unpatentable over Aizawa, Inokawa, and Ohsaki. Pet. 42–45.

Because we have already determined that these claims are unpatentable based on Aizawa and Inokawa, which is dispositive as to these challenged claims, we need not reach this additional ground applied to these

claims. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) ("[T]he Board need not address issues that are not necessary to the resolution of the proceeding.").

I. Obviousness over the Combined Teachings of Aizawa, Inokawa, Goldsmith, and Lo

Petitioner contends that claims 23–25 are unpatentable over Aizawa, Inokawa, Goldsmith, and Lo. Pet. 51–56.

Because we have already determined that these claims are unpatentable based on Aizawa, Inokawa, and Mendelson-2006 (claims 23–24) or Mendelson-2006 and Beyer (claim 25), we need not reach this additional ground applied to these claims. *See SAS Inst.*, 138 S. Ct. at 1359; *Boston Sci.*, 809 F. App'x at 990.

J. Obviousness over the Combined Teachings of Mendelson-1988 and Inokawa

Petitioner contends that claims 1–14, 16–22, and 26–30 of the '190 patent would have been obvious over the combined teachings of Mendelson-1988 and Inokawa. Pet. 62–94.

1. Overview of Mendelson-1988 (Ex. 1015)

Mendelson-1988 discloses a pulse oximeter, with an optical reflectance sensor suitable for noninvasive monitoring of a user's arterial hemoglobin oxygen saturation (SpO_2), via the user's forehead. *See* Ex. 1015, 167 (title & abstract).

Figure 2 is reproduced below:

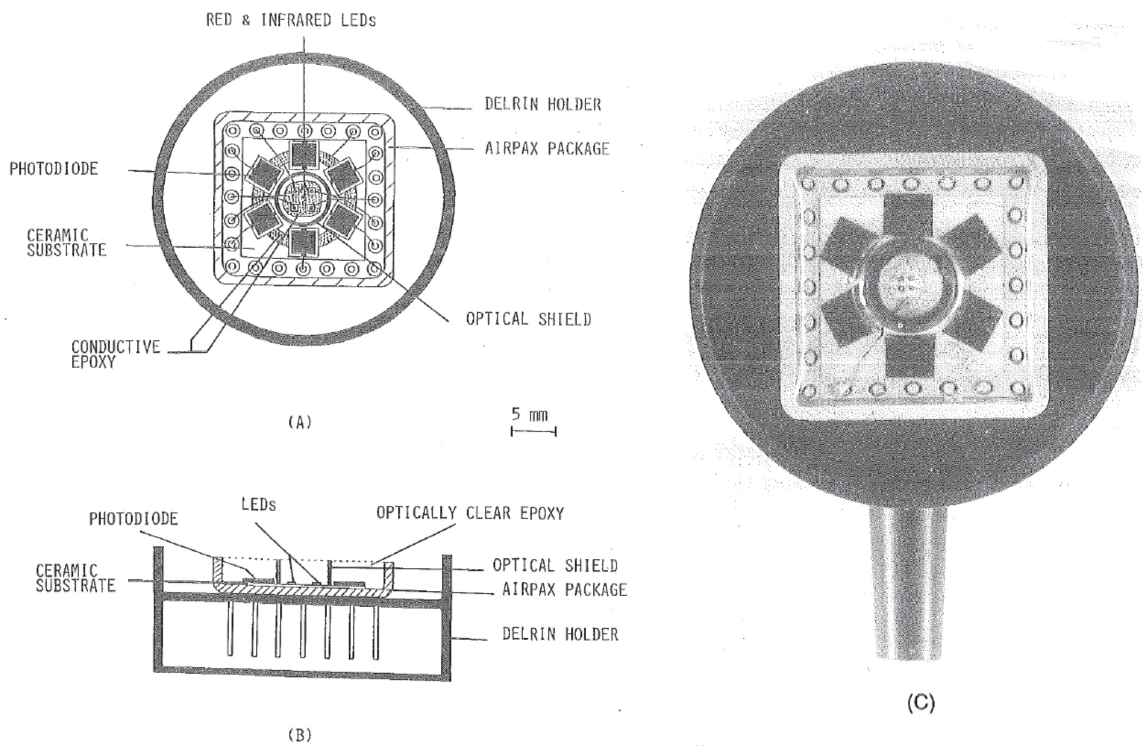


Figure 2 illustrates the sensor of Mendelson-1988, including: (A) a top view diagram; (B) a side view diagram; and (C) a photograph. *Id.* at 169.

The sensor includes two red LEDs and two infrared LEDs for emitting light into the user's tissue, and six photodiodes "arranged symmetrically in a hexagonal configuration" surrounding the four emitters, to detect light reflected back to the sensor from the user's tissue. *Id.* at 168 ("SENSOR DESIGN"). The user's "SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms." *Id.* at 167. "To minimize the amount of light transmission and reflection between the LEDs and the photodiodes within the sensor, a ring-shaped, optically opaque shield of black Delrin . . . was placed between the LEDs and the photodiode chips." *Id.* at 168 (col. 2). "The optical components were encapsulated inside the

package using optically clear adhesive." *Id.* "The microelectronic package was mounted inside a black Delrin housing." *Id.*

2. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Mendelson-1988 and Inokawa. Pet. 63–67 (combination), 68–75 (claim 1).

i. "A noninvasive optical physiological measurement device adapted to be worn by a wearer, the noninvasive optical physiological measurement device providing an indication of a physiological parameter of the wearer comprising"

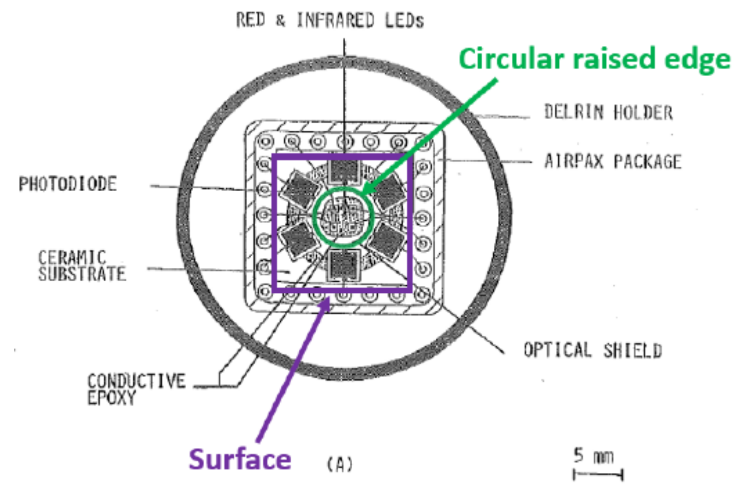
The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses a noninvasive optical physiological measurement device, i.e., an "optical reflectance sensor" that monitors "arterial hemoglobin oxygen saturation," a physiological parameter of the wearer. Pet. 68; *see, e.g.*, Ex. 1015, code (57), 167, 172; Ex. 1003 ¶ 157.

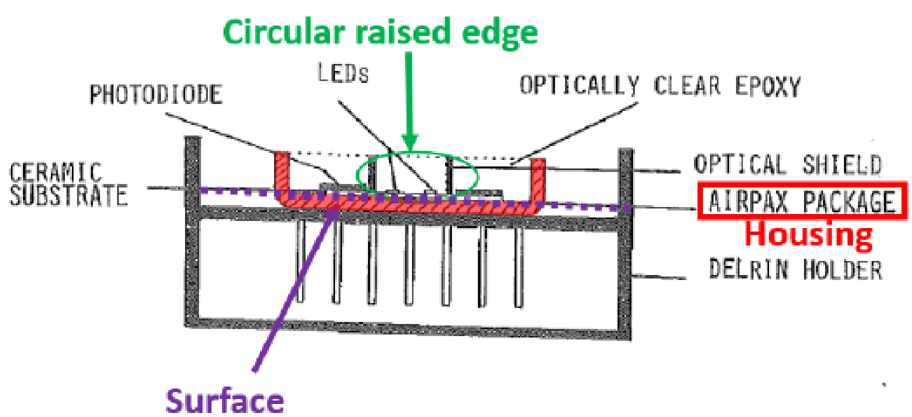
ii. "[a] one or more light emitters"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses two red LEDs and two infrared LEDs. Pet. 68; *see, e.g.*, Ex. 1015, 168 ("The optical reflectance sensor used in this study consists of two red (peak emission wavelength: 660 nm) and two infrared (peak emission wavelength: 930 nm) LED chips.")), Fig. 2(a); Ex. 1003 ¶ 158.

iii. "[b] a housing having a surface and a circular raised edge extending from the surface"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses an AIRPAX package, i.e., a housing with a ceramic substrate, i.e., a surface, and a circular raised edge extending from the surface. Pet. 69. Petitioner's annotated versions of Mendelson-1988's Figures 2A and 2B are reproduced below.





Pet. 69–70. The modified figures depict top and side views of Mendelson-1988's sensor with a housing (depicted in red) having a surface (depicted in

purple) with a circular raised edge (depicted in green) extending from the surface. *Id.*; Ex. 1003 ¶ 159.[8]

iv. "[c] at least four detectors arranged on the surface and spaced apart from each other, the at least four detectors configured to output one or more signals responsive to light from the one or more light emitters attenuated by body tissue, the one or more signals indicative of a physiological parameter of the wearer"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1998 discloses "six silicon photodiodes . . . arranged symmetrically in a hexagonal configuration" on the surface. Pet. 69, 72; *see, e.g.*, Ex. 1015, 168, Figs. 2(A)–(B). Mendelson-1998 discloses that the photodiodes output "current pulses" indicative of a physiological parameter of the wearer in response to light emitted by the emitters and reflected from the skin. Pet. 72–73; *see, e.g.*, Ex. 1015, 167 ("SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms."); Ex. 1003 ¶ 163.

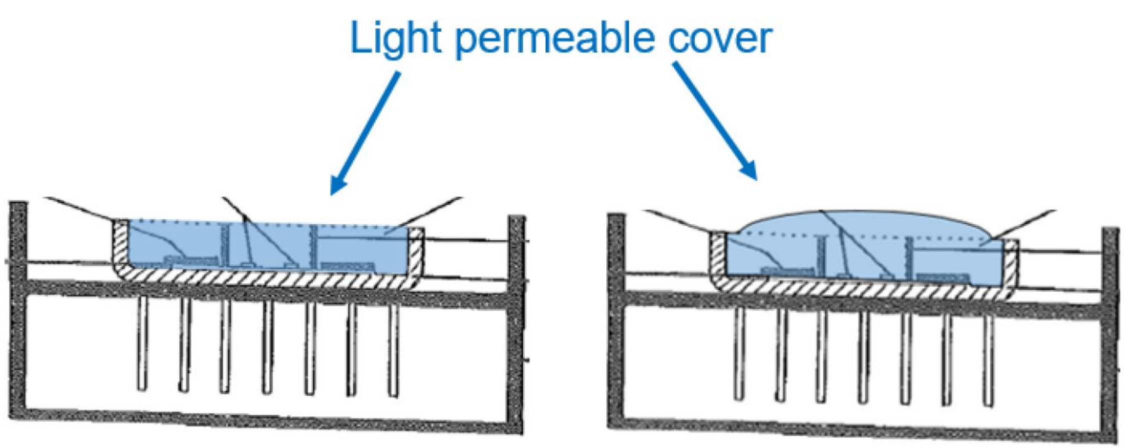
[8] Petitioner also alleges that, "[a]lternatively, the outer wall of the AIRPAX microelectronic package (housing), as indicated below, can be modified to be a circular raised edge extending from the surface." Pet. 70–72 (emphasis omitted). We do not rely on this alternative contention regarding claim 1.

v. *"[d] a light permeable cover arranged above at least a portion of the housing, the light permeable cover comprising a protrusion arranged to cover the at least four detectors."*

Petitioner's Contentions

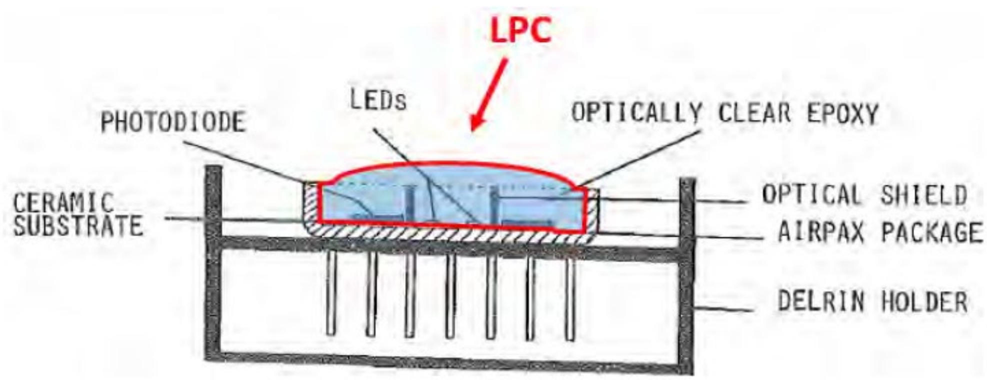
Petitioner contends that Mendelson-1988's sensor discloses all limitations of claim 1, except that its light permeable cover, i.e., the "OPTICALLY CLEAR EPOXY" in Figure 2B, which is arranged above a portion of the housing and covers the detectors, lacks the claimed "protrusion." *See* Pet. 73–75; Ex. 1003 ¶¶ 165–171. As discussed above in Section II.D.3, Petitioner contends that Inokawa's sensor includes lens 27, comprising a convex protrusion arranged to cover its light detector 25. Pet. 65. Petitioner reasons that an ordinarily skilled artisan would have been motivated, with a reasonable expectation of success, to modify Mendelson-1988's optical SpO_2 sensor, in light of Inokawa's optical pulse sensor, by adding a lens with a protrusion to Mendelson-1988's cover to improve the sensor's light detection efficiency. *Id.* at 66.

Dr. Kenny provides the following illustrations to portray the proposed modification of Mendelson-1988's sensor (Ex. 1003 ¶ 168):

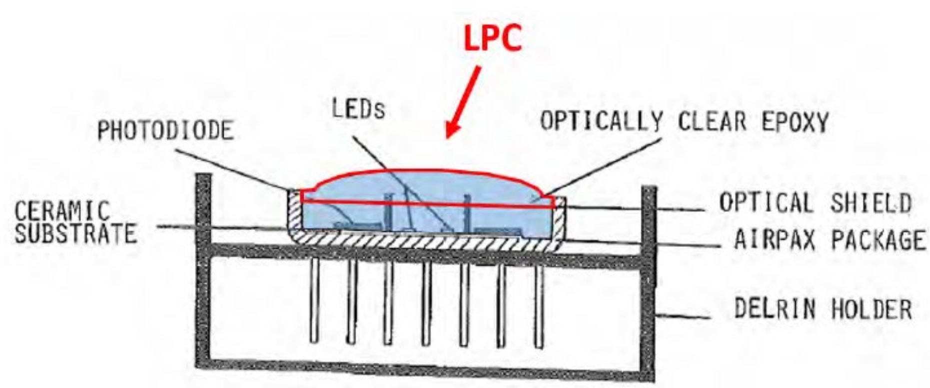


At the left, Dr. Kenny has excerpted and annotated Mendelson-1988's Figure 2B, to identify the pre-existing cover (colored blue) which covers the light emitters and detectors. *See id.* At the right, Dr. Kenny has illustrated the device resulting from the proposed modification of the cover to have a protrusion (also colored blue). *See id.*

Petitioner further asserts "there are two alternative ways of mapping the claimed 'light permeable cover,' or LPC, to the modified cover above." Pet. 74; Ex. 1003 ¶¶ 172–173. Dr. Kenny provides the following two annotations of Mendelson-1988's Figure 2B to identify these alternative mappings:



APPLE-1015, FIG. 2(B)



APPLE-1015, FIG. 2(B).

Dr. Kenny's first mapping (top figure) equates the cover to the entire depth of the epoxy contained within the AIRPAX package as shown in red outline. Ex. 1003 ¶ 172. Dr. Kenny's second mapping (bottom figure) equates the cover to a partial depth of the epoxy within the package as shown in red outline. *Id.* ¶ 173 ("[A person of ordinary skill in the art] would have been able to use the top portion of the housing . . ., as in Nishikawa, to help form the LPC portion on top of the sealing portion.").

Petitioner adds that a person of ordinary skill in the art "would have realized that the epoxy layer [of Mendelson-1998] could have been given a shape that would help further advance Mendelson-1988's objective of improving detection efficiency," "requir[ing] only routine knowledge of sensor design and assembly." Pet. 64, 66 (citing Ex. 1015, 168, 173); Ex. 1003 ¶¶ 165, 169. For example, "as demonstrated by Nishikawa, molding clear epoxy, as in Mendelson-1988, into a lens was well understood." Pet. 66–67 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35, 37; Ex. 1003 ¶ 170).

<u>Patent Owner's Arguments</u>

Patent Owner is of the view that Petitioner has not met its burden to demonstrate the obviousness of modifying Mendelson-1988's sensor to have a protrusion, based on substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. *See* PO Resp. 43–46; Ex. 2004 ¶¶ 94–100; *supra* Section II.D.3. For example, Mendelson-1988, like Aizawa, provides a central emitter or emitters surrounded by several detectors. *Compare* Ex. 1015, 169 (Fig. 2) (showing four central LEDs surrounded by six photodiodes), *with* Ex. 1006,

Figs. 1(a)–1(b) (showing one central LED 21 surrounded by four photodetectors 22).

Patent Owner argues that Mendelson-1988 discloses only that it encapsulates its electronic components with a flat optically clear adhesive/epoxy, which is not a "cover." PO Resp. 46 (citing Ex. 1004 ¶¶ 102–103). Patent Owner contends that the '190 patent distinguishes between resin and covers. PO Resp. 47 (citing Ex. 1001, 36:37–46). Patent Owner also argues that Nishikawa, on which Petitioner relies, "never mentions a cover, and instead discusses encapsulation of components using an integrally molded resin." *Id.* (citing Ex. 1023 ¶ 35). Likewise, Patent Owner characterizes Inokawa's cover as a "***distinct structure***, not an undifferentiated mass of resin on a surface." *Id.* (citing Ex. 1008 ¶ 103).

Patent Owner also objects to Petitioner's alternative mapping, providing for a cover with a protrusion to be found in two different ways. *See* PO Resp. 46–49; Ex. 2004 ¶¶ 102–107. This alternative mapping, in according to Patent Owner, is "ambiguous[]," and the second mapping incorporates an "arbitrary" line drawn to define the bottom of the cover in "an ***undifferentiated*** mass of material." PO Resp. 48–49. Patent Owner also argues that "Petitioner's inability to consistently identify a 'cover' reveals the hindsight-driven nature of its arguments." *Id.* at 49.

Petitioner's Reply

Petitioner maintains that the Petition and supporting testimony adequately account for the "cover" required by the claims of the '190 patent, including the "alternative mapping" configuration. Pet. Reply 22.

Patent Owner's Sur-reply

Patent Owner's Sur-reply generally reiterates its arguments challenging Petitioner's contentions. PO Sur-reply 18–20.

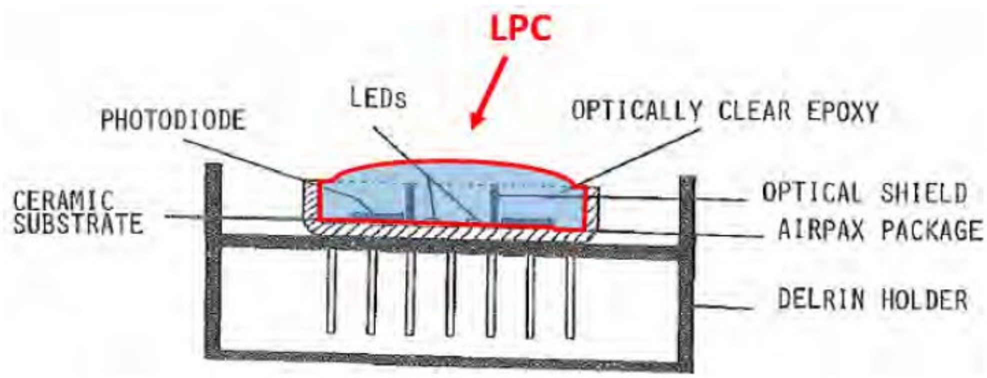
Analysis

As an initial matter, we find that a preponderance of the evidence establishes that the Mendelson-1988 sensor's optically clear epoxy is a light permeable cover that is arranged above a portion of the housing and covers the sensor's detectors. In particular, it is clear from Figures 2A and 2B that the epoxy extends from the top of the sensor at the dotted line in the figure, down into the well of the AIRPAX package, to cover all four LEDs and all six photodiodes disposed at the bottom of the well. *See also* Ex. 1015, 168 ("The optical components were encapsulated inside the package using optically clear adhesive."). Although Patent Owner disagrees, its position is premised on its proposed claim construction of the term "cover" as excluding resins and epoxies. *See* PO Resp. 46–48. For reasons provided in Section II.A.1 above, we do not find that claim construction persuasive, and Patent Owner does not distinguish Mendelson-1988 from claim 1 on this basis.

Thus, we determine that Petitioner has established persuasively that Mendelson-1988's sensor teaches every limitation of claim 1, except that its light permeable cover has a flat surface and, thus, does not include a "protrusion." We, however, conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the top surface of Mendelson-1988's cover to include a protrusion, in order to increase the amount of backscattered light received by Mendelson-1988's peripheral detectors. Our reasoning is substantially identical to the analysis

provided above in connection with the ground based on Aizawa and Inokawa, with Mendelson-1988 replacing Aizawa in the combination. *See supra* Section II.D.3. Patent Owner does not cite, and we do not discern, any material difference between Mendelson-1988 and Aizawa that might lead to a different result here, with one possible exception.

That difference is Petitioner's alternative mapping of the claimed "cover" in the proposed modification of Mendelson-1988. We rely on the first mapping, but not the second, to decide in Petitioner's favor. Petitioner's first mapping is again reproduced here (Ex. 1003 ¶ 172):



APPLE-1015, FIG. 2(B)

In this modified and annotated version of Figure 2B of Mendelson-1988, Dr. Kenny identifies how Mendelson-1988's light permeable cover may be modified to have a protrusion, wherein the modified cover (colored blue) includes the entire depth of the optically clear epoxy contained within the AIRPAX package (outlined red). *Id.*; Pet. 74. Patent Owner objects to this mapping as ambiguous, but we determine Dr. Kenny's annotations reproduced above are sufficiently clear to establish obviousness by a preponderance of the evidence.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

3. Independent Claim 26

Independent claim 26 consists of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:37–53, *with id.* at 46:22–40 (reciting a "circular housing" with a "wall"; reciting a "lens portion . . . in optical communication with the . . . detectors"). In asserting that claim 26 would have been obvious over the combined teachings of Mendelson-1988 and Inokawa, Petitioner refers to many of the same contentions presented as to claim 1. *See* Pet. 88–91; Ex. 1003 ¶¶ 206–212.

We address the parties' contentions to the extent they vary or expand upon those discussed above. We do not address contentions that we have already considered with respect to independent claim 1.

With respect to the limitation reciting "a lens portion . . . comprising a protrusion in optical communication with the at least four detectors," Petitioner additionally contends that "because reflected light received by Mendelson-1988's six detectors passes through the protruded lens portion as provided by Inokawa, the lens/protrusion is in optical communication with the detectors." Pet. 91. We agree. As discussed in Section II.J.2.v, we are persuaded that an ordinarily skilled artisan would have been motivated, with a reasonable expectation of success, to modify Mendelson-1988's sensor, in light of Inokawa's sensor, by adding a protruding lens to Mendelson-1988's cover to improve the sensor's light detection efficiency. *See, e.g.*, Pet. 66. In the proposed modification, emitted and reflected light passes through the

added lens/protrusion, taught by Inokawa, before reaching the detectors. Ex. 1003 ¶ 211. As such, we agree that it is "in optical communication," as claimed.

With respect to the limitation reciting "a circular housing comprising a surface and a wall protruding from the surface," Petitioner contends that "[a]lthough the housing [of Mendelson-1998] appears to have a square shape, not a circular one, a [person of ordinary skill in the art] would have recognized that microelectronic packaging as used in Mendelson-1988 comes in various shapes and sizes," and that such an artisan "would have considered using a differently shaped housing, namely a circular one, to be obvious" because a circular housing with a circular wall was well known and the shape would have imparted nothing new or inventive. Pet. 89–90 (citing, e.g., Ex. 1003 ¶¶ 206–209). For example, Petitioner relies on Mendelson-799,[9] which discloses a sensor for an optical measurement device having a circular shape. *Id.* (citing Ex. 1025, Fig. 7, 9:34–36).

Patent Owner argues that Mendelson-1988 and Inokawa provide square housings for their components. PO Resp. 52. According to Patent Owner, "Petition never identifies a motivation to pick a circular-shaped housing instead of the existing square shape" and that a skilled artisan would not have made such a modification without some perceived benefit for doing so. *Id.* at 53 (citing, e.g., Ex. 2004 ¶ 114). Patent Owner objects to Petitioner's reliance on the sensor shape taught by Mendelson-799 because (1) Mendelson-799 is not included in any ground, and (2) Mendelson-799

---

[9] U.S. Patent No. 6,801,799 B2, filed Feb. 6, 2003, issued Oct. 5, 2004 ("Mendelson-799," Ex. 1025).

does not disclose a cover and, as such, "cannot disclose a circular housing and a cover of the circular housing, as claim 26 requires." *Id.*

In its Reply, Petitioner contends that "neither the '190 patent nor [Patent Owner] provides any explanation of how the particular housing shape solves some problem or presents some unexpected result." Pet. Reply 24.

In its Sur-reply, Patent Owner reiterates its positions from its Response. PO Sur-reply 21.

We are persuaded by Petitioner's contentions. As discussed in Section II.J.2.iii, Mendelson-1988 discloses a housing in the form of an AIRPAX package that has a square shape when viewed from above. *See* Ex. 1015, Fig. 2(A). Petitioner's and Dr. Kenny's general assessment that a person of ordinary skill in the art would have understood that a circular housing shape was a known option for housing components of a physiological sensor finds support in the record. Pet. 88–90; Ex. 1003 ¶¶ 208–209. In that respect, although Mendelson-799 was not listed in the styling of the proposed grounds of unpatentability, its teachings plainly were offered in the Petition as evidence of the background knowledge that an ordinarily skilled artisan would have brought to bear in an evaluation of the teachings of Mendelson-1988 and Inokawa. Pet. 88–90. Moreover, it is clear that Patent Owner understood that the proposed ground offered in the Petition considered the disclosure of Mendelson-799, and Patent Owner had opportunity to address that disclosure. Indeed, Patent Owner availed itself of that opportunity during trial (*see, e.g.*, PO Resp. 53; PO Sur-reply 21).

We further find unavailing Patent Owner's argument that "Mendelson[-799] does not disclose a cover (or even epoxy encapsulation)

and thus cannot disclose a circular housing and a cover of the circular housing, as claim 26 requires." PO Resp. 53. Figure 7 of Mendelson-799 is reproduced below:

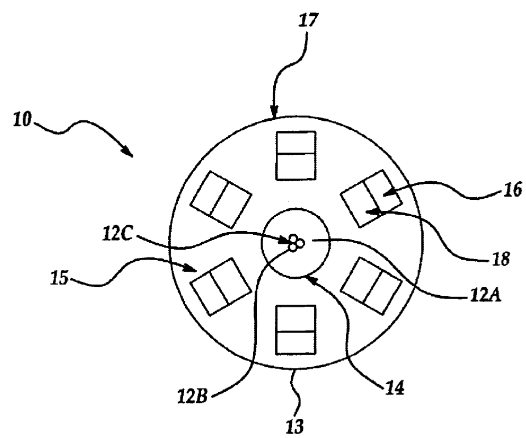


Figure 7

Figure 7 is a top view of optical sensor 10 comprising light source 12 composed of three LEDs 12A, 12B, and 12C emitting light of three different wavelengths, and an array of six near detectors 18 and six far detectors 16 "arranged in two concentric ring-like arrangements" surrounding light source 12. Ex. 1025, 9:23–34. "All these elements are accommodated in a sensor housing 17" which, as can be seen in Figure 7, is clearly circular. *Id.* at 9:34–35. Patent Owner does not articulate why the presence or absence of a cover in Mendelson-799 somehow serves to discount the unambiguous presentation of a sensor housing having a circular shape.

Furthermore, one of ordinary skill in the art would have understood that the AIRPAX package of Mendelson-1988 and the housing 17 of Mendelson-799 are performing the same function of enclosing a central collection of light emitters which are surrounded by an array of light detectors in an optical sensor attached to a user's body. *See, e.g.*, Ex. 1015, Figs. 2A–2B; Ex. 1025, Fig. 7. The evidence of record also does not suggest that the shape of such a housing has any functional significance in the

operation of the optical sensor, or that any particular shape was preferred or restricted. Thus, the evidence suggests that a square shape and a circular shape of such a housing were known in the art to be predictable substitutes for one another, and therefore obvious variants. *See, e.g.*, *KSR*, 550 U.S. at 416 ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."); *id.* at 417 ("[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." (citation omitted)).

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 26 would have been obvious over the cited combination of references.

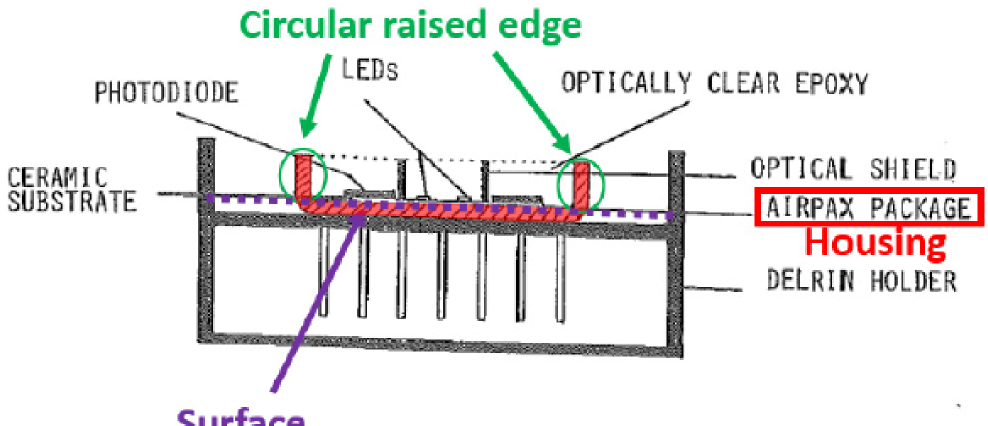
4. Dependent Claims 2–14, 16–22, and 27–30

i. Dependent Claim 3

Dependent claim 3 recites that "the circular raised edge creates a gap between the surface and the light permeable cover." Ex. 1001, 44:58–60.

For this claim, Petitioner relies upon a different mapping of the "circular raised edge" than that primarily relied upon in claim 1. *See supra* § II.J.2.iii, n.8 (identifying, but not relying upon, Petitioner's alternate mapping). Specifically, Petitioner contends that although Mendelson-1988's sensor presents a square shape, it would have been obvious to a skilled artisan that a circular shape, and circular raised edge, could have been used. Pet. 71; *see also supra* § II.J.3 (similar arguments regarding claim 26).

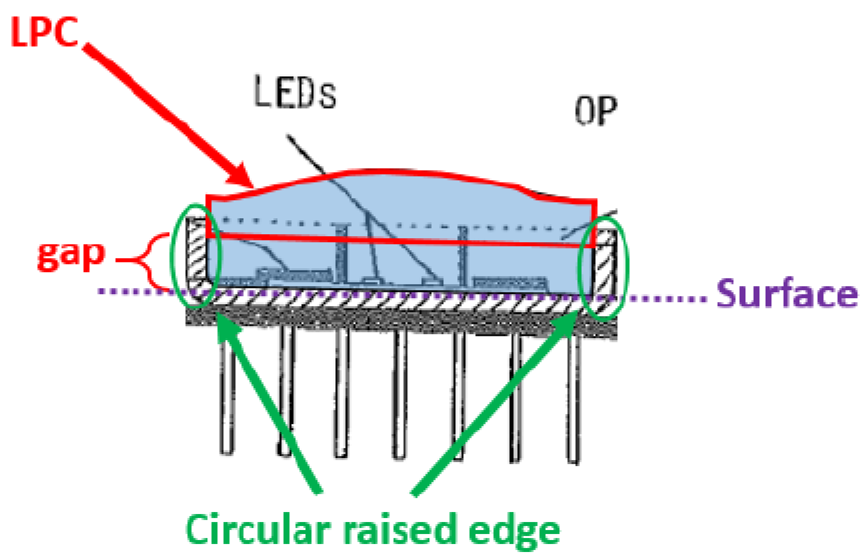
Petitioner presents an annotated version of Mendelson-1988's Figure 2(B) below.



(B)

The annotated figure identifies an outer edge of Mendelson-1988's AIRPAX package with the label "Circular raised edge." Pet. 71; Ex. 1003 ¶ 160.

Regarding claim 3, Petitioner contends that, in the modified sensor of Mendelson-1988 and Inokawa, "the [light permeable cover] portion is separated from the surface by a gap," as shown below. Pet. 76.



The annotated and modified figure above presents Mendelson-1988's sensor with the epoxy formed to extend from the bottom surface upward through a protruding cover, and with a line identifying the upper portion of the epoxy

that Petitioner contends is the light permeable cover. Thus, according to Petitioner, "[t]he size of the gap above is defined, in part, by the raised edge of the housing, which as described above for [1b] can be circular, that surrounds the epoxy structure and serves as a mold that define its overall height (and thus the size of the gap)." Pet. 77 (citing Ex. 1023 ¶¶ 34–38, Figs. 5–6; Ex. 1003 ¶¶ 178–179).

In response, Patent Owner argues that "drawing an arbitrary line through an undifferentiated mass of material does not create a 'gap,'" and characterizes Petitioner's alternate mappings as ambiguous. PO Resp. 49 (citing Ex. 2004 ¶¶ 108–109; Ex. 2007, 355:12–359:5). Patent Owner argues that the term "gap" requires some kind of "break," which is absent in the proposed combination. *Id.* (citing Ex. 1001, 36:24–28; Ex. 1017; Ex. 2004 ¶ 110). Moreover, Patent Owner argues that in this mapping, it is not the circular raised edge that "creates" the gap, as claimed. *Id.* at 51.

In its Reply, Petitioner contends that "the 'line' between the LPC/cover and the epoxy encapsulation layer underneath is not arbitrary, instead being formed, for instance, by a common manufacturing technique for creating epoxy lenses in which the epoxy lens layer is provided on top of a separately formed epoxy encapsulation layer." Pet. Reply 23–24 (citing Ex. 1003 ¶¶ 178–179; Ex. 1047 ¶ 49).

In its Sur-reply, Patent Owner argues that Petitioner's reliance on Nishikawa for teachings of how to manufacture separate epoxy layers is unavailing because Nishikawa's process seeks to avoid any gaps in the epoxy. PO Sur-reply 21 (citing Pet. 67).

Upon review of the foregoing, we conclude Petitioner's case for the obviousness of claim 3 falls short. Petitioner's identification of the bottom

border of the LPC "cover" in this mapping is arbitrary, and is not supported by a preponderance of the evidence. Dr. Kenny does not provide any persuasive reasoning in support of his identification of the "cover" as terminating at the bottom border he has identified, when the same mass of epoxy extends further beyond that border to the surface of the sensor. *See* Ex. 1003 ¶¶ 90–91. We perceive no such reasoning, apart from impermissible hindsight.

Dr. Kenny testifies that "the height of the 'circular wall' in Mendelson-1988 necessarily impacts the position of the LPC (cover), in turn necessarily impacting the size of the 'gap' between the cover and the surface," and, as such, the "line" between the cover and epoxy underneath is not arbitrary. Ex. 1047 ¶ 49; *see also* Ex. 1003 ¶ 90. Instead, Dr. Kenny asserts, this represents a common manufacturing technique to form separate layers of epoxy, for example, as taught by Nishikawa. Ex. 1047 ¶ 49 (citing Ex. 1023 ¶¶ 34–38, Figs. 5–6).

But we find this testimony deficient in two primary ways. First, Dr. Kenny's reliance on Nishikawa is misplaced. Dr. Kenny relies on Nishikawa's disclosure that sealing portion 40 and lens unit 50 may be formed in separate injection molding steps, leading to a defined border between them which is shown as a horizontal line in Nishikawa's Figure 6. Ex. 1023 ¶¶ 34–35. Thus, Nishikawa *does* establish, as Dr. Kenny testifies, that Mendelson-1988's epoxy layer *could* have been formed in a two-step injection molding process, leading to a border between two layers of epoxy. However, Dr. Kenny errs in "focus[ing] on what a skilled artisan would have been *able* to do, rather than what a skilled artisan would have been *motivated* to do." *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056,

1068–69 (Fed. Cir. 2018) (citing *InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014)). Dr. Kenny does not provide any persuasive motivation for using Nishikawa's two-step molding process within the context of Mendelson-1988's sensor. Thus, we conclude Dr. Kenny "succumbed to hindsight bias in [his] obviousness analysis." *InTouch*, 751 F.3d at 1352.

Second, Dr. Kenny's testimony that the height of the circular wall impacts the position of the cover is belied by Dr. Kenny's illustration of the proposed modification in which the "line" dividing the cover from the epoxy is located *below* the full height of the circular wall. *See* Ex. 1047 ¶ 48. Thus, in no way does the AIRPAX package wall create the gap. Instead, the identified "gap" (to the extent it can be named as such) is created by the height of the lower layer of epoxy purportedly laid down in Nishikawa's first injection molding step.

For the foregoing reasons, we conclude Petitioner has not demonstrated by a preponderance of the evidence that claim 3 is unpatentable over Mendelson-1988 and Inokawa. Dependent claims 6–14 and 16 depend further from claim 3 and, as such, Petitioner's contentions with respect to those claims also fail.

ii. Dependent Claim 5

Petitioner identifies dependent claim 5 as being challenged in its proposed ground of unpatentability based on Mendelson-1988 and Inokawa. *See* Pet. 2 (listing claims 1–14, 16–22, and 26–30 as part of this ground), 62 (heading identifying the same challenged claims). But, Petitioner does not present any contentions addressing the specific limitations of claim 5. *See*

id. at 75–94 (purportedly addressing all challenged claims beyond claim 1). As such, Petitioner has not met its burden.

iii. Dependent Claims 2, 4, 17–22, and 27–30

Petitioner presents undisputed contentions that claims 2, 4, 17–22, and 27–30, which depend directly or indirectly from independent claim 1 or 26, are unpatentable over the combined teachings of Mendelson-1988 and Inokawa, and provides arguments explaining how the references teach the limitations of these claims. Pet. 75–78, 84–87, 91–94; Ex. 1003 ¶¶ 174–175, 180, 198–203, 213–219.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claims 1 and 26. PO Resp. 57 ("The Petition fails to establish that independent claims 1 and 26 are obvious over the cited references of Ground 2A and therefore fails to establish obviousness of any of the challenged dependent claims.").

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2, 4, 17–22, and 27–30 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

K. Obviousness over the Combined Teachings of Mendelson-1988, Inokawa, and Mendelson-2006

With support from the testimony of Dr. Kenny, Petitioner contends that claims 23 and 24 would have been obvious over the combined teachings of Mendelson-1988, Inokawa, and Mendelson-2006. Pet. 94–97 (citing

Ex. 1003 ¶¶ 220–224; Ex. 1008 ¶ 56; Ex. 1015, 167, 171, Fig. 2; Ex. 1016, 912–915, Figs. 1–3; Ex. 1022). For instance, Petitioner applies the teachings of Mendelson-2006 to account for the mobile monitoring device features required by claim 23 and the touch-screen display recited in claim 24. *Id.*

Patent Owner does not separately address this ground, urging only that the ground "do[es] not fix the Petition's deficiencies" alleged in connection with the ground based on Mendelson-1988 and Inokawa. PO Resp. 57. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.J.

We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claims 23 and 24 are unpatentable based on Mendelson-1988, Inokawa, and Mendelson-2006.

L. Obviousness over the Combined Teachings of Mendelson-1988, Inokawa, Mendelson-2006, and Beyer

With support from the testimony of Dr. Kenny, Petitioner contends that claim 25 would have been obvious over the combined teachings of Mendelson-1988, Inokawa, Mendelson-2006, and Beyer. Pet. 97–99 (citing, e.g., Ex. 1003 ¶¶ 224–231; Ex. 1016, 913–914; Ex. 1019, 1:6–15, Fig. 1). For instance, Petitioner applies the teachings of Beyer to account for the processor features required by claim 25. *Id.*

Patent Owner does not separately address this ground, urging only that the ground "do[es] not fix the Petition's deficiencies" alleged in connection with the ground based on Mendelson-1988 and Inokawa. PO Resp. 57. As discussed above, we do not agree with Patent Owner as to any such deficiencies. *See supra* § II.J.

We have reviewed the Petition and its supporting evidence and conclude that Petitioner has shown by a preponderance of the evidence that claim 25 is unpatentable based on Mendelson-1988, Inokawa, Mendelson-2006, and Beyer.

III. CONCLUSION

In summary:[10]

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–14, 16, 17, 19–23, 26–29	103	Aizawa, Inokawa	1–14, 16, 17, 19–23, 26–29	5
23, 24	103	Aizawa, Inokawa, Mendelson-2006	23, 24	
25	103	Aizawa, Inokawa, Mendelson-2006, Beyer	25	
5	103	Aizawa, Inokawa, Al-Ali	5	

[10] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

23–25	103[11]	Aizawa, Inokawa, Goldsmith, Lo		
1–14, 16, 17, 19–23, 26–29	103[12]	Aizawa, Inokawa, Ohsaki		
1–14, 16–22, 26–30	103	Mendelson-1988, Inokawa	1, 2, 4, 5, 17–22, 26–30	3, 5–14, 16
23, 24	103	Mendelson-1988, Inokawa, Mendelson-2006	23, 24	
25	103	Mendelson-1988, Inokawa, Mendelson-2006, Beyer	25	
Overall Outcome			1–14, 16–30	

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–14 and 16–30 of the ’190 patent have been shown to be unpatentable; and

[11] As explained above, because we conclude that the challenged claims are unpatentable on other grounds, we do not reach the merits of this ground.
[13] As explained above, because we conclude that the challenged claims are unpatentable on other grounds, we do not reach the merits of this ground.

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

For PETITIONER:

Walter K. Renner
Andrew Patrick
Hyun Jin In
Roberto J. DeVoto
FISH & RICHARDSON P.C.
axf-ptab@fr.com
patrick@fro.com
in@fr.com
devoto@fr.com

For PATENT OWNER:

Jarom D. Kesler
Joseph R. Re
Stephen W. Larson
Jacob L. Peterson
KNOBBE, MARTENS, OLSEN, & BEAR, LLP
2jzk@knobbe.com
2jrr@knobbe.com
2slw@knobbe.com
2jup@knobbe.com

Trials@uspto.gov
571-272-7822

Paper 32
Date: June 1, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2021-00208
Patent 10,258,266 B1

Before JOSIAH C. COCKS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges.*

KINDER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition (Paper 2, "Pet.") pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–6, 8–16, 18, and 19 ("challenged claims") of U.S. Patent No. 10,258,266 B1 (Ex. 1001, "the '266 patent"). We instituted the petitioned review (Paper 7).

Masimo Corporation ("Patent Owner") filed a Patent Owner Response (Paper 15, "PO Resp.") to oppose the Petition. Petitioner filed a Reply (Paper 18, "Pet. Reply") to the Patent Owner Response. Patent Owner filed a Sur-reply (Paper 22, "Sur-reply") to the Reply. We conducted an oral hearing on March 15, 2022. A transcript has been entered into the record (Paper 31, "Tr.").

We have jurisdiction under 35 U.S.C. § 6(b)(4) and § 318(a). This Decision is a final written decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of claims 1–6, 8–16, 18, and 19 of the '266 patent. We determine Petitioner has shown by a preponderance of the evidence that those claims are unpatentable.

B. Related Matters

The parties identify the following matters related to the '266 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01716 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1);

Apple Inc. v. Masimo Corporation, IPR2021-00193 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,299,708 B1);

Apple Inc. v. Masimo Corporation, IPR2021-00195 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,376,190 B1); and

Apple Inc. v. Masimo Corporation, IPR2021-00209 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,376,191 B1).

Pet. 1, 72–73;[1] Paper 3, 1, 3–4.

Patent Owner further identifies certain issued patent applications, as well as other pending and abandoned applications, that claim priority to, or share a priority claim with, the ’266 patent. Paper 3, 1–3.

C. The ’266 Patent

The ’266 patent is titled “Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents,” and issued on April 16, 2019, from U.S. Patent Application No. 16/212,537, filed December 6, 2018. Ex. 1001, codes (21), (22), (45), (54). The ’266 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/086,060, 61/086,108, 61/086,063, and 61/086,057, each filed on August 4, 2008, as well as 61/091,732 filed on

[1] Petitioner lists “U.S. Patent[] 10,299,708 (IPR2020-00193)” as a related *inter partes* review petition. Pet. 73. The case number associated with Patent No. 10,299,708 B1 is IPR2021-00193 and not “IPR2020-00193” as listed by Petitioner.

August 25, 2008, and 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The '266 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:31–33. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:22–28, 55–58. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:35–41.

Figure 1 of the '266 patent is reproduced below.

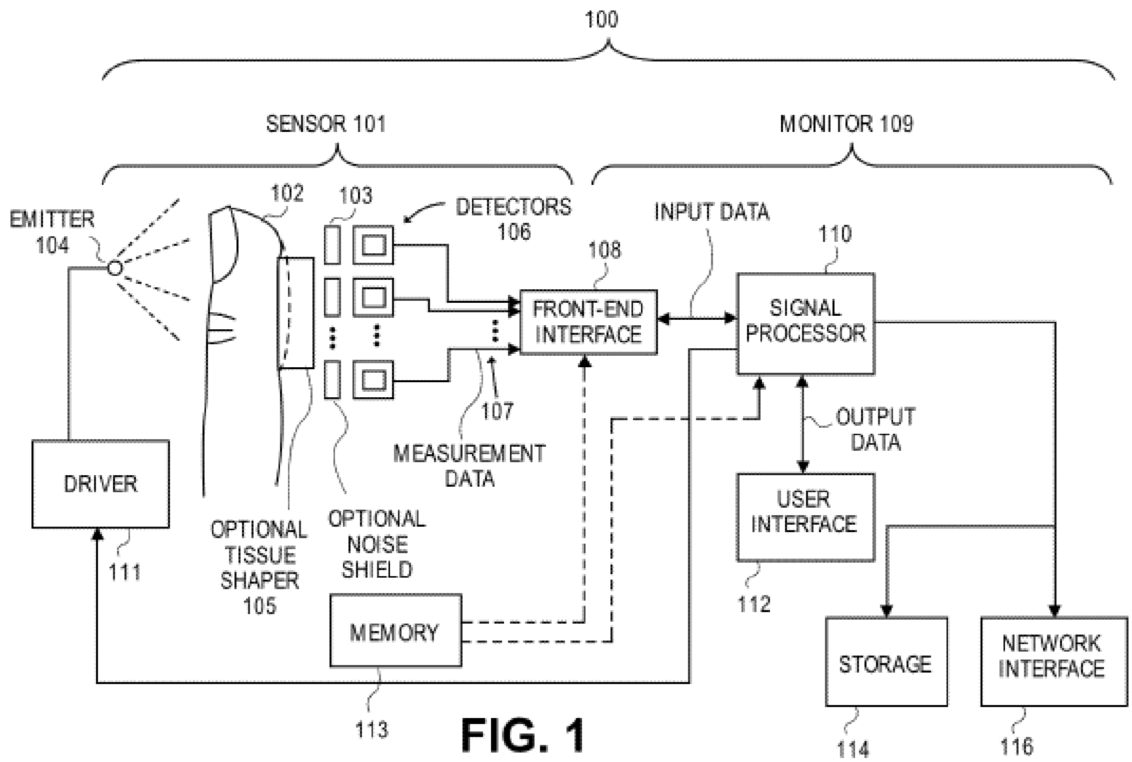


FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:36–38. Sensor 101 includes emitter 104 and detectors 106. *Id.* at 11:48–50. Emitter 104 emits light that is attenuated or reflected by the patient's tissue at measurement site 102. *Id.*

at 13:61–64. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signal 107 to monitor 109 through front-end interface 108. *Id.* at 14:16–22. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 10:59–11:3.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:6–8. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors 106." *Id.* at 15:12–15. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:38–42. In response to user input or device orientation, user interface 112 can "reorient its display indicia." *Id.* at 15:44–48. The monitor may include storage device 114 and network interface 116. *Id.* at 15:52–54. In some embodiments, the monitor, including the display, is attached to the patient by a strap. *Id.* at 17:64–67.

The '266 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate sensor devices.

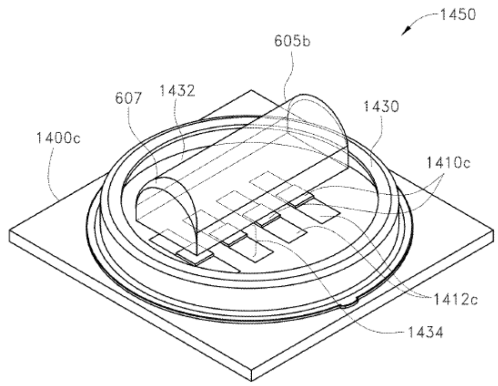


FIG. 14D

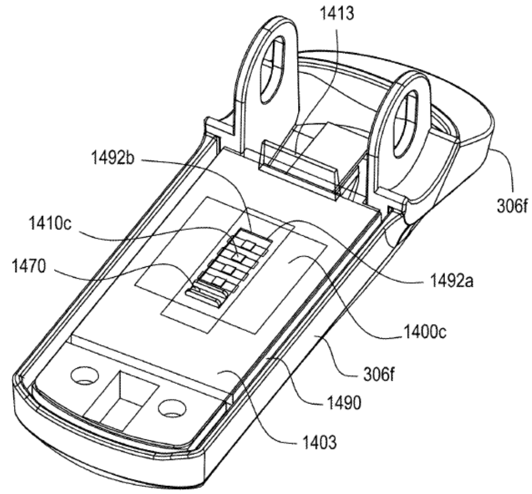


FIG. 14F

Figure 14D illustrates a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:34–37. As shown in Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b is disposed. *Id.* at 36:17–24. Figure 14F illustrates detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 36:63–64. In some embodiments, the detector shell includes walls to separate individual photodiode arrays and to "prevent or reduce mixing of light signals." *Id.* at 22:28–31. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* at 36:65–37:8.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

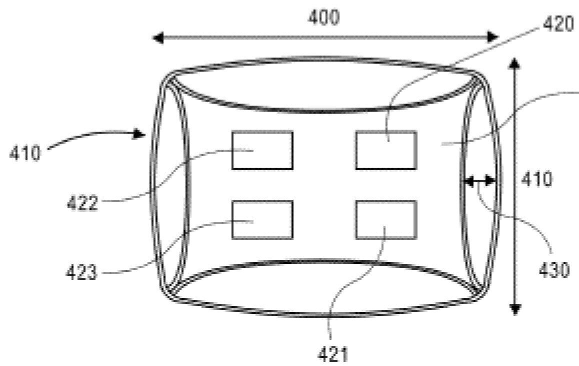


FIG. 4A

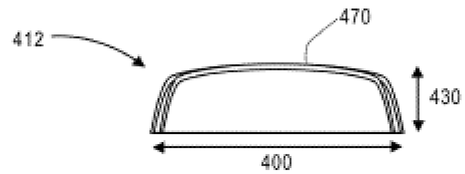


FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement site contact area 470. *Id.* at 23:8–14. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, the measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:31–33. The measurement site contact area includes windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:39–53.

D. Illustrative Claim

Of the challenged claims, claims 1 and 9 are independent. Claim 1 is illustrative and is reproduced below.

> 1. A noninvasive optical physiological sensor comprising:
>
> [a] a plurality of emitters configured to emit light into tissue of a user;
>
> [b] a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprise at least four detectors;
>
> [c] a housing configured to house at least the plurality of detectors; and
>
> [d] a lens configured to be located between the tissue of the user and the plurality of detectors when the noninvasive

> optical physiological sensor is worn by the user, wherein the lens comprises a single outwardly protruding convex surface configured to cause tissue of the user to conform to at least a portion of the single outwardly protruding convex surface when the noninvasive optical physiological sensor worn by the user and during operation of the noninvasive optical physiological sensor.

Ex. 1001, 44:36–54 (bracketed lettering [a]–[d] added). Independent claim 9 includes limitations similar to limitations [a]–[d] of claim 1, and also includes additional recitations. *Id.* at 45:13–23 (additionally reciting "a lens forming a cover," "a circular housing including a planar surface" and a "grid pattern").

E. Applied References

Petitioner relies upon the following references:

> Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1014, "Ohsaki");
>
> Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, "Aizawa");
>
> Inokawa et al., Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006 (Ex. 1007, "Inokawa");[2] and
>
> Y. Mendelson, et al., "Design and Evaluation of a New Reflectance Pulse Oximeter Sensor," Association for the Advancement of Medical Instrumentation, Vol. 22, No. 4, 167–173 (1988) (Ex. 1015, "Mendelson-1988").

Pet. 2.

---

[2] Petitioner relies on a certified English translation of Inokawa (Ex. 1008). Ex. 1008, 24. In this Decision, we also refer to the translation.

Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003), and the Second Declaration of Thomas W. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Vijay K. Madisetti, Ph.D. (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this and other proceedings. *See* Exs. 1034–1036, 2006–2009, 2020, 2027.

F. Asserted Grounds

Petitioner asserts that claims 1–6, 8–16, 18, and 19 are unpatentable based upon the following grounds (Pet. 2):[3]

Claims Challenged	35 U.S.C. §	References/Basis
1–6, 8–16, 18, and 19	103	Aizawa, Inokawa
1–6, 8–16, 18, and 19	103	Aizawa, Inokawa, Ohsaki
1–6, 8–16, 18, and 19	103	Mendelson-1988, Inokawa

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R.

[3] In a section titled "Challenge," Petitioner asserts, *inter alia*, that claims 17, 18, and 29 are unpatentable over 35 U.S.C. § 103 based on the combination of Mendelson-1988, Inokawa, Mendelson-2006 and Beyer. Pet. 1–2. However, Mendelson-2006 and Beyer are not listed as exhibits in the Petition (*see id.* at ii–iii), were not produced into the record as evidence, and Petitioner does not present any arguments regarding the patentability of claims 17, 18, and 29 over these references. The alleged ground challenging claims 17, 18, and 29 based on Mendelson-1988, Inokawa, Mendelson-2006 and Beyer is not part of the Petition and claims 17 and 29 are not addressed in this Decision.

§ 42.100(b) (2019). Although both parties contend that no claim term requires express construction (Pet. 3–4; PO Resp. 10), the substance of the parties' briefing demonstrates that there is a dispute regarding the claim term "cover," which appears in independent claim 9.

1. "cover"

Independent claim 9 requires "a lens forming a cover of the circular housing." Ex. 1001, 45:21. Although independent claim 1 also recites "a lens," it does not recite a "cover." *Id.* at 44:37–54.

Patent Owner argues that the claimed "cover" excludes "an optically clear adhesive/epoxy" and a "resin on a surface." PO Resp. 52. According to Patent Owner, "the '266 Patent distinguishes a resin on a surface from a cover, explaining: 'the cylindrical housing 1430 (and transparent cover 1432) . . . can protect the detectors 1410c and conductors 1412c ***more effectively*** than currently-available ***resin epoxies***.'" *Id.* (quoting Ex. 1001, 36:37–46).

Patent Owner alleges that Dr. Kenny also "distinguished a sealing resin from a cover, acknowledging a 'layer of sealing resin' is 'one way to protect the components ***without using a cover***.'" *Id.* at 52–53 (quoting Ex. 2009, 395:22–396:17). Patent Owner argues its understanding is consistent with the prior art cited by Petitioner. *Id.* at 53 (citing Ex. 1008 ¶ 103, Fig. 17; Ex. 1023 ¶ 35; Ex. 2004 ¶¶ 113–115).

Petitioner replies that "there is nothing in the specification or the prosecution history [of the '266 patent] that would lead a [person of ordinary skill in the art] to conclude that 'cover' should be interpreted based on anything other than its plain meaning." Pet. Reply 24 (citing *Thorner v. Sony Computer Entertainment America LLC*, 669 F.3d 1362, 1368 (Fed. Cir.

2012)). That plain meaning, according to Petitioner, is that "a cover is merely 'something that protects, shelters, or guards.'" *Id.* (quoting Ex. 1050; Ex. 1047 ¶ 48). Petitioner argues that Patent Owner's reliance on the '266 patent Specification takes text out of context and, when context is considered, it is clear that "the epoxy resin to which the '266 patent compares its cover is not [an] epoxy cover . . . but rather epoxy that is applied to solder joints." *Id.* at 24–25 (citing Ex. 1001, 36:50–59; Ex. 1047 ¶ 50).

Petitioner also contends that Patent Owner "mischaracterizes Dr. Kenny's deposition testimony to say he agreed that 'sealing resin' is somehow distinguished from a cover." *Id.* at 24. Petitioner contends that Dr. Kenny simply "clarified that using a sealing resin is 'a pretty common way to protect electronic components.'" *Id.* (citing Ex. 2009, 395:22–396:17; Ex. 1047 ¶ 49). Moreover, Petitioner contends that "such extrinsic evidence would not justify departure from plain meaning under *Thorner*." *Id.*

In its Sur-reply, Patent Owner maintains that the '266 patent "specifically ***distinguishes*** a 'resin' on a surface from a 'cover,'" and Petitioner's opposing reading is not persuasive. PO Sur-reply 20–21.

Upon review of the record, we disagree with Patent Owner's limiting construction of "cover" to exclude epoxy and resin. The plain and ordinary meaning of the term does not support Patent Owner's view. A "cover" ordinarily connotes "something that protects, shelters, or guards." Ex. 1050 (*Merriam-Webster's Collegiate Dictionary*, 11th ed. (©2005)), 288. That plain and ordinary meaning is consistent with the '266 patent's description of "flex circuit cover 360, which can be made of plastic or another suitable material . . . [and] can cover and thereby protect a flex circuit (not shown)."

Ex. 1001, 22:63–65. It also is consistent with the '266 patent's description and illustration of "transparent cover 1432" in Figure 14D, which covers and protects detectors 1410c and conductors 1412c, and which "can be fabricated from glass or plastic, *among other materials*." *See id.* at 36:30–42 (emphasis added), Figs. 14D–14E.

This is not the situation in which a special definition for a claim term has been set forth in the specification with reasonable clarity, deliberateness, and precision, so as to give notice of the inventor's own lexicography. *See Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005); *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Nor do we discern that Patent Owner "demonstrate[d] an intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope." *Teleflex, Inc. v. Ficosa North America Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002).

Here, based upon our review of the intrinsic evidence, no such special definition or express disavowal of the term "cover" to exclude epoxy and resin exists. Patent Owner relies on the following description of Figure 14D in that regard:

> *In certain embodiments, the cylindrical housing 1430 (and transparent cover 1432)* forms an airtight or substantially airtight or hermetic seal with the submount 1400c. As a result, the cylindrical housing 1430 can protect the detectors 1410c and conductors 1412c from fluids and vapors that can cause corrosion. Advantageously, *in certain embodiments, the cylindrical housing 1430 can protect* the detectors 1410c and conductors 1412c *more effectively than currently-available resin epoxies*, which are sometimes applied to solder joints between conductors and detectors.

Ex. 1001, 36:37–46 (emphases added); *see* PO Resp. 52. First, the sentence cited by Patent Owner begins with the phrase "[i]n certain embodiments," which indicates the claimed invention is not limited and is open to other embodiments, so there is no lexicography or disavowal here. Second, we agree with Petitioner's reading of this passage as distinguishing the prior art from the claimed invention based on the *location* of the material (applied only to solder joints between conductors and detectors in the prior art, as opposed to covering the conductors and detectors in the invention) and not the *type* of material. Third, at best, the '266 patent expresses a preference for a cover to be made of glass or plastic, because such materials provide "more effective[]" protection than resin epoxies that were known when the '266 patent was filed. *See id.* at 36:42–46. But even this reading recognizes that resin epoxies provide some amount of protection, albeit perhaps a lesser amount than glass or plastic, and are not excluded from forming the material of a cover.

Dr. Kenny's deposition testimony cited by Patent Owner also does not persuade us that, in the context of the '266 patent, epoxy or resin is excluded from the material of a cover. Dr. Kenny testifies that "a layer of sealing resin" "[c]ould" be used to protect the electronic components in a sensor (Ex. 2009, 395:22–396:8). He was then asked "So that would be one way to protect the components without using a cover, correct?" to which he answered "[t]here are many ways to protect the elements other than using a cover" and maintained that the proposed combination of prior art has a "cover" to achieve purposes *other than* protecting electronic components, i.e., "to improve adhesion and to improve light gathering for the operation of the system." *Id.* at 396:9–17. He did not squarely testify that sealing resin may never be a cover.

Accordingly, in the context of the ’266 patent, we do not construe the claimed “cover” to exclude epoxy and resin.

2. Other Claim Terms

Upon consideration of the entirety of the arguments and evidence presented, we conclude no further explicit construction of any claim term is needed to resolve the issues presented by the arguments and evidence of record. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (per curiam) (claim terms need to be construed “only to the extent necessary to resolve the controversy” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.[4] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion

[4] Patent Owner does not present objective evidence of non-obviousness.

claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information." Pet. 4 (citing Ex. 1003 ¶¶ 21–22). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.*

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 10–11 (citing Ex. 2004 ¶¶ 35–38).

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Aizawa and Inokawa

Petitioner contends that claims 1–6, 8–16, 18, and 19 of the '266 patent would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 7–44.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

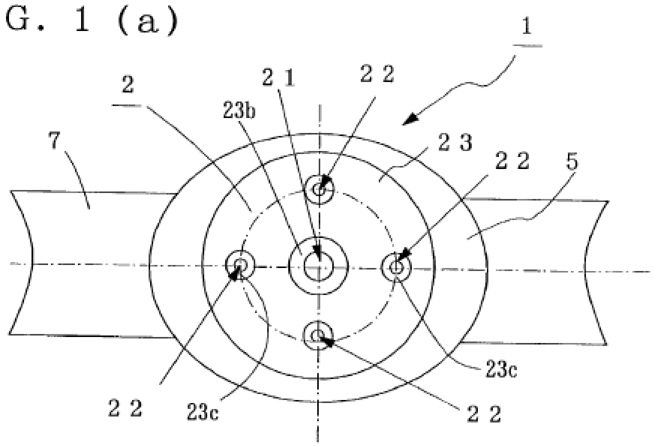


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

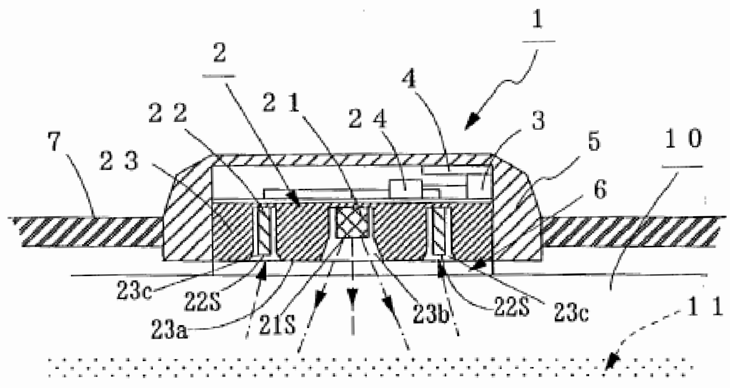


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.*

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)." *Id.* ¶ 26. Furthermore, "the above belt 7 is fastened such that the acrylic

transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶¶ 26, 34.

2. Overview of Inokawa (Ex. 1008)

Inokawa is a Japanese published patent application titled "Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method," and discloses a pulse sensor device. Ex. 1008 ¶ 6.

Figure 1 of Inokawa is reproduced below.

(FIG. 1)

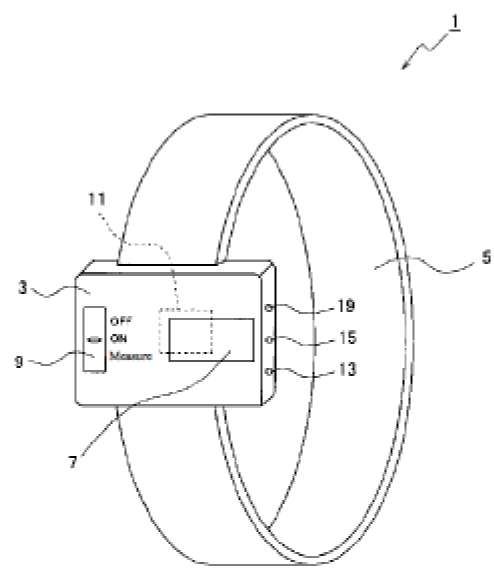


Figure 1 illustrates a schematic view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user's pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

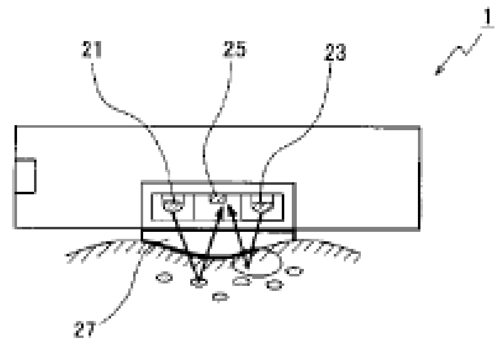


Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of light-emitting elements, i.e., green LED 21 and infrared LED 23, as well as photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 senses "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 senses body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory." *Id.* ¶ 69.

Figure 3 of Inokawa is reproduced below.

(FIG. 3)

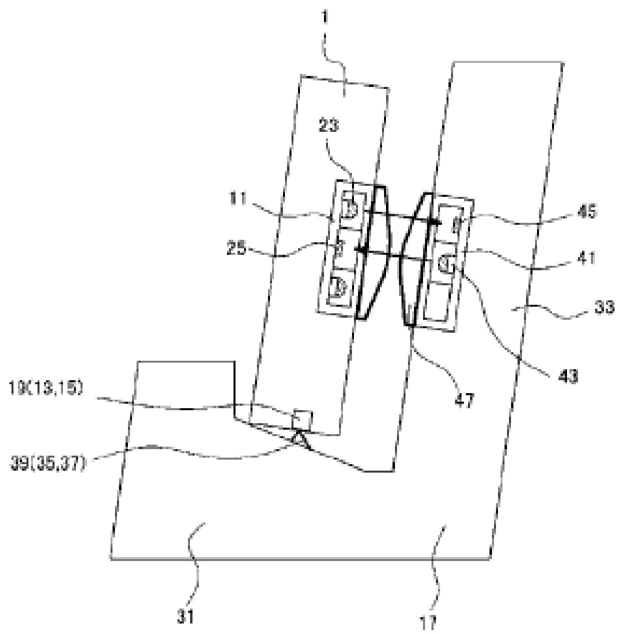


Figure 3 illustrates a schematic view of a pulse sensor mounted to a base device. *Id.* ¶ 60. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* When so mounted, sensor optical device component 11 and base optical device component 41 face each other in close proximity. *Id.* ¶ 66. In this position, pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76. In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 13–23 (combination), 23–30 (claim 1).

i. A noninvasive optical physiological sensor comprising:"

On this record, the cited evidence supports Petitioner's undisputed contention that Aizawa discloses a noninvasive optical physiological sensor, i.e., a pulse sensor worn on a wearer's wrist. Pet. 23; *see, e.g.*, Ex. 1006 ¶ 2 ("[A] pulse wave sensor for detecting the pulse wave of a subject from light reflected from a red corpuscle in the artery of a wrist of the subject by irradiating the artery of the wrist with light.").

ii. [a] "a plurality of emitters configured to emit light into tissue of a user;"

Petitioner's Undisputed Contentions

Petitioner contends that Aizawa discloses one emitter—LED 21—and also states that, in certain embodiments, multiple LEDs may be employed. Pet. 7–8, 17–18. Patent Owner does not dispute this contention, and we agree with Petitioner. *See* Ex. 1006 ¶¶ 23 ("LED 21"), 32 ("The arrangement of the light emitting diode 21 and the photodetectors 22 is not limited to this."). For example, Aizawa explains that "[t]he same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector." *Id.* ¶ 33.

Petitioner also contends that Inokawa teaches a sensor with two LEDs–a green LED to sense pulse and an infrared LED to sense body motion. Pet. 10–11. Petitioner contends that when Inokawa's sensor is

mounted on a base device, the infrared LED also is used to wirelessly transmit vital information to the base device. *Id.* at 12–13. Patent Owner does not dispute these contentions, and we agree with Petitioner. Inokawa teaches a pair of LEDs 21, 23, where "the basic function of the S-side green LED 21 is to sense the pulse from the light reflected off of the body . . ., while the S-side infrared LED 23 serves to sense body motion from the change in this reflected light." Ex. 1008 ¶¶ 58–59. Inokawa also explains that "vital sign information stored in the memory 63 [of the sensor], such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17," such that "there is no need to use a special wireless communication circuit or a communication cable." *Id.* ¶¶ 76–77.

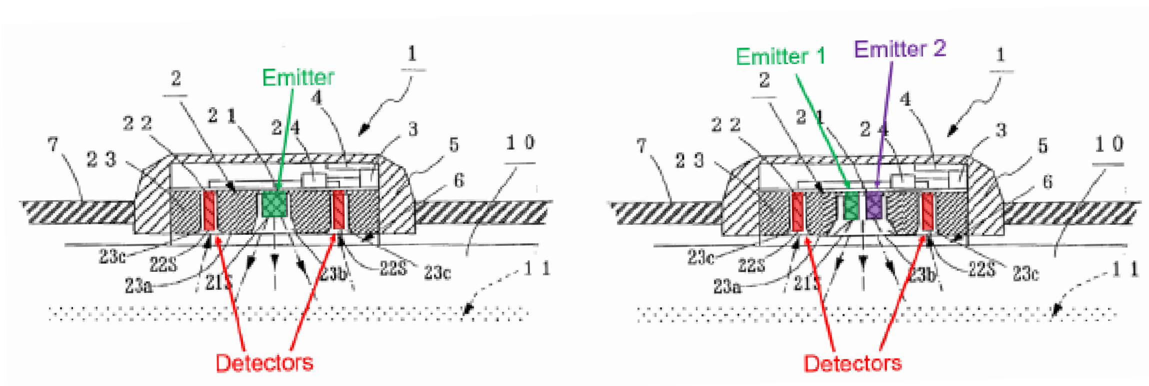
Petitioner's Disputed Contentions

Moreover, Petitioner contends that a person of ordinary skill in the art would have been motivated to "provid[e] an additional emitter to Aizawa [to] allow Aizawa's device to use its existing infrared LED to detect body motion while using the added green LED to detect pulse," which would have provided "more reliable pulse measurement that takes into account and corrects for inaccurate readings stemming from body movement." Pet. 18, 24; Ex. 1003 ¶¶ 71–73.

As a second and independent motivation, Petitioner also contends that incorporating Inokawa's teachings would have allowed for wireless data communication from Aizawa's sensor, without the need for a physical communications cable or a separate wireless communication circuit. Pet. 20–21. Petitioner contends that although Aizawa discloses data transmission, Aizawa "is silent about how such transmission would be

implemented." *Id.* at 20. According to Petitioner, a skilled artisan "would have further recognized that incorporating Inokawa's base device and LED-based data transmission would allow Aizawa to upload data from its sensor in a way that is wireless (thus avoiding the problems of a physical cable) and that does not require a separate RF circuit," and which would "improve data transmission accuracy by using the second LED, such as the green LED, to transmit checksum information." *Id.* at 21 (citing, e.g., Ex. 1003 ¶¶ 76–78).

To illustrate its proposed modification, Petitioner includes annotated and modified views of Aizawa's Figure 1(b), reproduced below. Pet. 19; *see also id.* at 24 (same); Ex. 1003 ¶ 72.



Petitioner's modified figures depict the sensor of Aizawa in which the single emitter has been divided into two emitters operating at two different wavelengths, as Petitioner contends would have been rendered obvious by Inokawa. Pet. 18–19, 23–24. Petitioner contends that this modification entails use of a known solution to improve similar systems in the same way and would have achieved predictable results. *Id.* at 19, 22–23 (citing Ex. 1003 ¶¶ 73–74, 80); *see also id.* at 23–24 (citing, e.g., Ex. 1003 ¶¶ 69–81).

Patent Owner's Arguments

Patent Owner disputes Petitioner's contentions regarding the obviousness of modifying Aizawa to include two emitters. *See* PO Resp. 37–43; Sur-reply 13–15.

First, Patent Owner argues that neither Aizawa nor Inokawa discloses a device with both multiple detectors *and* multiple emitters in the *same* sensor, because Aizawa's embodiments have either a single emitter and multiple detectors (e.g., Ex. 1006, Fig. 1(a)) or multiple emitters and a single detector (e.g., *id.* ¶ 33), and Inokawa discloses multiple emitters and a single detector (e.g., Ex. 1008, Fig. 2). *See* PO Resp. 37–38 (citing, e.g., Ex. 2004 ¶¶ 79–80).

Second, Patent Owner argues that the evidence does not support either of Petitioner's two proffered motivations for modifying Aizawa to include two emitters. As to the first motivation (to measure body movement using a second emitter), Patent Owner asserts that Dr. Kenny erroneously testifies that Aizawa cannot do this with its single emitter. PO Resp. 38 (citing, e.g., Ex. 1006 ¶ 15; Ex. 2007, 400:7–401:10; Ex. 2004 ¶ 84). Patent Owner argues that "Aizawa, however, expressly states that it provides a 'device for ***computing*** the ***amount*** of motion load from the pulse rate.'" *Id.* at 39.

As to Petitioner's second motivation (to enable transmission of data to a base device using an optical communication link), Patent Owner argues that "Aizawa ***already*** includes a wireless transmitter . . . so Aizawa does not need to incorporate Inokawa's base-device [optical] data transmission arrangement." PO Resp. 39–40 (citing, e.g., Ex. 1006 ¶¶ 23, 28, 35; Ex. 2004 ¶¶ 85–86). Indeed, Patent Owner argues "Dr. Kenny acknowledged Aizawa does not indicate there are any problems with Aizawa's form of data transmission." *Id.* at 40 (citing Ex. 2007, 409:13–

410:2). Patent Owner further argues that "Aizawa's goal is 'real-time measuring' with the transmitter 'transmitting the measured pulse rate data to a display'" but that "Inokawa's base device, however, only transmits pulse rate data 'when the pulse sensor . . . is mounted onto the base device'" and, thus, "***eliminates*** the ability to take and display ***real-time*** measurements." *Id.* at 40–41 (citing, e.g., Ex. 1006 ¶¶ 4, 15; Ex. 1008, Abstract; Ex. 2004 ¶ 86; Ex. 2009, 381:18–382:8, 383:22–385:9, 390:5–392:3).

Patent Owner insists Inokawa does not aid Petitioner's case, because Inokawa discloses the benefits of using a second emitter in only two situations, i.e., first, to improve over a "mechanically-connected system," e.g., with a cable for communication, and, second, to avoid use of a "dedicated wireless communication circuit," whereas "Aizawa ***already*** uses wireless transmission to provide real-time heart measurements." *Id.* at 41–42 (citing, e.g., Ex. 1008 ¶ 4; Ex. 2004 ¶ 87).

Third, Patent Owner accuses Petitioner and Dr. Kenny of overlooking further complications that would ensue from modifying Aizawa to have two emitters. Patent Owner argues that Dr. Kenny overlooked how placing "two LEDs in close proximity may cause thermal interference that could create significant issues for sensor performance." PO Resp. 42 (citing, e.g., Ex. 2004 ¶ 88; Ex. 2012, 76–77). Patent Owner also argues that in the proposed modification, when Dr. Kenny added a second LED, "he widened [Aizawa's] cavity in his figure without disclosing in his declaration that he had done so," which could impact optical performance of the device. *Id.* at 42–43.

Petitioner's Reply

Concerning Petitioner's first motivation, Petitioner asserts that Aizawa does not disclose any details related to data transmission, and adding an additional LED enables the sensor to distinguish between blood flow and body movement, which provides a "more reliable" pulse measurement, which is Petitioner's asserted improvement to Aizawa. Pet. Reply 16 (citing, e.g., Ex. 1003 ¶ 72; Ex. 2007, 401:11–402:4; Ex. 1047 ¶ 36). Moreover, Petitioner contends that by using multiple LEDs at different wavelengths, "two separate signals" can be collected, which "will allow Aizawa's system to 'take into account and correct for inaccurate readings related to body movement' by subtracting the 'signal component corresponding to body movement [] from the pulse signal to help better isolate the desired pulse data.'" *Id.* (quoting Ex. 1003 ¶ 72).

Concerning Petitioner's second motivation, Petitioner maintains that Inokawa's use of two emitters having different wavelengths to upload data to a base device using optical communication advantageously improves the accuracy of the transmission by providing checksum information. *Id.* at 17 (citing, e.g., Ex. 1003 ¶ 78; Ex. 1008 ¶ 111, 44, 48; Ex. 2007, 407:7–408:20, 416:5–15; Ex. 1047 ¶ 38). Moreover, Petitioner notes that Aizawa mentions real-time measurement only once and does not "mention that such data must also be transmitted to some external device in real time." *Id.* at 18 (citing Ex. 1047 ¶ 38). Likewise, Petitioner explains that a person of ordinary skill in the art "would have been fully capable of weighing potential benefits associated with different transmission methods, for instance recognizing that a quicker transmission may be achieved in one instance and a more accurate one in another." *Id.*

As to the "other complications" that Patent Owner alleges would result from the proposed modification, Petitioner asserts "such issues are 'part of what [a person of ordinary skill in the art] would bring . . . to the problem and would know how to make the changes needed.'" *Id.* at 18 (quoting Ex. 2007, 384:8–388:12; Ex. 1047 ¶ 39).

Patent Owner's Sur-reply

Concerning Petitioner's first motivation, Patent Owner argues that Inokawa's disclosure is just as sparse as Aizawa's disclosure regarding how to use optical data to measure body movement. Sur-reply 13–14 (citing Ex. 1008 ¶ 59). Patent Owner also asserts that "Petitioner cites nothing in Inokawa that suggests" that Inokawa's two emitter data gathering is more reliable or otherwise superior to Aizawa's single emitter data gathering. *Id.*

Concerning Petitioner's second motivation, Patent Owner argues that the proposed modification eliminates Aizawa's ability to conduct "***real-time*** collection and display of physiological measurements—a key goal of Aizawa's system." *Id.* at 14 (citing Ex. 1006 ¶¶ 4, 15; Ex. 2007, 402:6–11; Ex. 2020 ¶ 101).

Patent Owner also notes that Petitioner does not dispute that the proposed modification would cause problems such as "additional cost, energy use, and thermal problems" that would ensue from using two emitters in the Aizawa device. *Id.* at 15.

Analysis

Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's contention that it would have been

obvious to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, in light of Inokawa.

First, a person of ordinary skill in the art would have been motivated to make this replacement to improve the pulse measurements recorded by Aizawa's detector 1. Inokawa teaches that the infrared LED's signal can be used "to detect vital signs" such as "body motion," and the green LED's signal can be "used to detect pulse." Ex. 1008, Fig. 2, ¶¶ 14, 58–59.

Patent Owner correctly points out that Aizawa describes its single-emitter detector 1 as transmitting its pulse data to "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶¶ 15, 28, 35. But, this description is the only disclosure in Aizawa cited by Patent Owner as relating to computing a motion characteristic of the user. Further, we are unable to discern any other disclosure in Aizawa relating to motion computation, or what Aizawa proposes to do with its motion computation. *See id.* Based on the sparse nature of Aizawa's disclosure concerning motion load, it is not clear exactly what Aizawa proposes to do with the computed motion load, after it is computed. *See, e.g.*, Ex. 1047 ¶ 36 ("Patent Owner fails to explain how Aizawa senses and computes motion load. Indeed, Aizawa is completely silent on this point."). Aizawa does, however, describe the motion load as being computed "from the pulse rate," rather than being an input to the pulse rate calculation. Ex. 1006 ¶¶ 15, 35.

In a deposition for other proceedings related to this *inter partes* review, *see supra* § I.B, Dr. Kenny was asked whether it was his understanding that "Aizawa's sensor could not account for motion load?"; Dr. Kenny answered that "Aizawa's sensor attempts to prevent motion load rather than account for it." Ex. 2007, 400:7–11 (deposition for IPR2020-01520, IPR2020-01537, and IPR2020-01539). He explained that, because

Aizawa uses only a single emitter with a single wavelength, "what [Aizawa] sees as a signal would be some mixture of pulse rate and motion load if there was no effort to prevent motion load," so Aizawa seeks to solve the problem of "prevent[ing] motion load from corrupting the pulse rate signal." *Id.* at 400:12–401:10. Dr. Kenny did not further explain this distinction between preventing and accounting for motion load in his deposition testimony cited by the parties as relating to this issue. *Id.* at 400:7–402:4. We do not rely on this distinction as a basis for our present decision, because we find no express support for it in Aizawa's disclosure (*see* Ex. 1006 ¶¶ 15, 28, 35), and it is not explained in persuasive detail by Dr. Kenny.

We nonetheless credit Dr. Kenny's declaration testimony that a person of ordinary skill in the art, upon reviewing Inokawa's disclosure of using two emitters of different wavelengths to calculate a user's pulse and motion separately, would have understood that these two separate measurements would "allow for a more reliable pulse measurement that takes into account *and corrects for* inaccurate readings stemming from body movement" by "subtracting the 'signal component corresponding to body movement [] from the pulse signal to help better isolate the desired pulse data." Ex. 1047 ¶¶ 36, 37 ("processed in a way to compensate for movement and create a more reliable measurement of the physiological parameter"); Ex. 1003 ¶¶ 71–73. Aizawa does not disclose using the computed motion load in this fashion, so it appears that this would improve upon the accuracy of Aizawa's pulse measurements, by using the computed motion load to isolate and account for noise. *See* Ex. 1006 ¶¶ 15, 28, 35.

Dr. Madisetti offers no meaningful opposing testimony in this regard. *See, e.g.*, Ex. 2004 ¶ 84. Instead, Dr. Madisetti incorrectly reads Dr. Kenny's motivation testimony as being limited to the desirability of

adding the bare ability to measure body movement to Aizawa. *See id.* In fact, Dr. Kenny further testified that it would have been beneficial to *use* the measured body movement to *improve* the pulse measurement of the device. *See* Ex. 1003 ¶¶ 71–74; Ex. 1047 ¶¶ 36–37. Dr. Madisetti does not address that testimony. *See* Ex. 2004 ¶ 84.

Thus, because Dr. Madisetti's testimony sets up a straw man to attack, rather than directly addressing the entirety of Dr. Kenny's testimony in this regard, Dr. Kenny's testimony stands unrebutted in the record before us. Dr. Kenny's testimony also makes intuitive sense that measuring the user's motion *separately* from the user's pulse, for example by using two interrogating emitters of two different wavelengths, would provide a reliable means of correcting the pulse data for motion artifacts by using the separately measured motion data, rather than by trying to segregate these two components in the single data stream provided by Aizawa's single emitter device. *See, e.g.*, Ex. 1047 ¶¶ 36–37. We, therefore, are persuaded by Dr. Kenny's unrebutted testimony that using two emitters of different wavelengths would improve Aizawa's device in this way.

Independently, we are also persuaded that a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, to provide a reliable method of uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for display to the user. Inokawa expressly touts such optically-based uploading of data from Inokawa's wrist-worn sensor 1 to Inokawa's base device 17 as a benefit of incorporating two emitters in sensor 1. *See* Ex. 1008, Figs. 3, 19, ¶¶ 3–7, 14, 76–77, 109–111. Inokawa identifies two specific benefits of this optically-based data communication means. First, the infrared LED can transmit the pulse data, and the green

LED can separately transmit "checksum" information to increase the accuracy of data transmission. *Id.* at Fig. 19, ¶¶ 14, 109–111. Second, using light emitters in this fashion to perform two functions (data collection by emitting light into the user's wrist, and data transmission by emitting light to photodetectors in a base device) obviates the need for providing "a special wireless communication circuit [in the wrist-worn sensor 1] or a communication cable." *Id.* ¶¶ 3–7, 76–77.

Patent Owner correctly points out that Aizawa already has a "transmitter" 4 for uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for processing and for display to the user. Ex. 1006, Fig. 1(b), ¶¶ 15, 23, 28, 35. However, Aizawa's Figure 1(b) illustrates transmitter 4 only as an empty box contained within outer casing 5, and Aizawa's written description does not provide further structural details concerning transmitter 4. *See id.* In particular, Aizawa does not describe exactly how transmitter 4 transmits its data to the other device. *See id.*

Patent Owner contends that Aizawa's transmitter 4 is a "wireless" transmitter, and Dr. Kenny agreed to as much during his deposition. *See, e.g.*, PO Resp. 40; Ex. 2007, 414:19–21. They appear to equate "wireless" communication to radio frequency communication, and not to include optical communication, even though both radio frequency and optical communication do not use a wire. Based on the foregoing testimony, we assume, for this decision, that Aizawa contemplates radio frequency communication as one embodiment by which transmitter 4 may transmit data to devices other than detector 1.

Patent Owner argues, and Dr. Madisetti testifies, that Aizawa's express disclosure goes even further. They assert Aizawa's "goal" is to

measure and display pulse data *in real time during exercise*, using the wireless transmitter. *See, e.g.*, PO Resp. 39–40; Ex. 2004 ¶¶ 86 ("the ability to take and display real-time measurements, one of Aizawa's stated goals"), 87. We find that Aizawa does not support this assertion. Instead, Aizawa discusses prior art devices that "estimat[e] a burden on the heart of a person who takes exercise by *real-time measuring* his/her heart rate at the time of exercise" (Ex. 1006 ¶ 4 (emphasis added)), and then describes Aizawa's detector 1 as having a transmitter for transmitting the measured pulse rate data to another device for display (*id.* ¶ 15). Aizawa does not indicate when this transmission occurs. Aizawa also refers to "noise caused by the shaking of the body of the subject" as a problem to be addressed (*id.* ¶ 6), but this problem occurs regardless of whether the shaking results from exercise or the normal movement of the user's wrist over the course of the day. Thus, Aizawa does not tout, as an important feature of Aizawa's invention, the *real time display* of pulse rate data during exercise, regardless of whether the data gathered by Aizawa's wrist-worn detector 1 is transmitted wirelessly or otherwise. *Id.* ¶¶ 4, 6, 15.

No doubt, a person of ordinary skill in the art would have viewed the capability of a wrist-worn pulse detector to transmit its pulse data to another device for display in real time while the user is exercising to be a desirable feature in some cases, even if this is not one of Aizawa's specifically stated goals. *See, e.g.*, Ex. 1048 ¶ 67 (Dr. Kenny stating: "By wirelessly transmitting the collected data . . . the condition of a subject [can be determined] 'remotely.'"); Ex. 2009, 393:6–14 (in a deposition for other related proceedings, Dr. Kenny agreeing that a person of ordinary skill in the art "would have seen the ability to wirelessly transmit collected data as an advantage"). Nonetheless, Inokawa expressly discloses that, in other cases,

the benefits achieved by wireless transmission can be outweighed by obviating the need for the wrist-worn sensor to include a special wireless communication circuit. *See* Ex. 1008 ¶¶ 3–7 (discussing problems associated with wireless transmission, such as the need for a dedicated circuit, which is avoided by Inokawa's system that risks "few malfunctions" and has a "simple structure"), 76–77 ("As a result, there is no need to use a special wireless communication circuit . . ., which makes it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction."). We therefore conclude that Petitioner's case for obviousness in this regard is supported by a preponderance of the evidence. *See, e.g., In re Urbanski*, 809 F.3d 1237, 1243–44 (Fed. Cir. 2016) (persons of ordinary skill in the art may be motivated to pursue desirable properties of one prior art reference, even at the expense of foregoing a benefit taught by another prior art reference).

We disagree with Patent Owner's argument that Petitioner's case for obviousness is deficient on the basis that neither Aizawa nor Inokawa expressly discloses a wrist-worn sensor device that has *both* a plurality of emitters *and* at least four detectors, as claim 1 recites. Obviousness does not require "'some motivation or suggestion to combine the prior art teachings' [to] be found in the prior art." *KSR*, 550 U.S. at 407, 415–418. Nor does it require the bodily incorporation of Inokawa's device into Aizawa's device. *See, e.g., In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (test for obviousness is not whether the features of one reference may be bodily incorporated into the structure of the other reference, but rather is "what the combined teachings of the references would have suggested to those of ordinary skill in the art"); *see also In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (nonobviousness is not established by attacking references

individually when unpatentability is predicated upon a combination of prior art disclosures). Instead, "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420–421.

In this case, we are persuaded that a person of ordinary skill in the art would have been motivated to modify Aizawa's wrist-worn detector 1 to replace its single near infrared LED 21 with an infrared LED and a green LED, based on Inokawa, for all the reasons provided above. A person of ordinary skill in the art would additionally have known to keep all four detectors 22 that are already present in Aizawa's detector 1, so that "[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately," as disclosed by Aizawa. Ex. 1006 ¶¶ 9, 27. In short, the combination of Aizawa and Inokawa teaches that having multiple emitters is beneficial, and having multiple detectors is beneficial, for different and not inconsistent reasons.

Finally, we agree with Petitioner's position that any thermal interference and power consumption issues that may arise in Aizawa's wrist-worn pulse detector, by using two emitters instead of one emitter, are well within the capabilities of a person of ordinary skill in the art to solve. We credit Dr. Kenny's testimony in this regard. *See* Ex. 1003 ¶¶ 74, 80 ("would have led to the predictable result of more accurate and convenient data transmission without significantly altering or hindering the functions performed by Aizawa's sensor"); Ex. 1047 ¶ 39. For example, Dr. Kenny acknowledges that Aizawa already discloses adding additional emitters. Ex. 1003 ¶ 39 (citing Ex. 1006 ¶ 33). Dr. Kenny further testifies that this modification "amount[s] to nothing more than the use of a known technique

[i.e., Inokawa's use of two emitters in a wrist-worn pulse detector] to improve similar devices [i.e., Aizawa's wrist-worn pulse detector] in the same way, and combining prior art elements according to known methods to yield predictable results." *Id.* ¶¶ 74, 80.

Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, indicate Dr. Kenny fails to appreciate the significance of optical interference complications posed by adding a second emitter to Aizawa's device, and fails to explain how this would have been overcome. *See* PO Resp. 42–43 (citing Ex. 2007, 379:17–21, 384:16–388:16, 389:17–390:20, 394:11–395:17). We have reviewed this deposition testimony, and we conclude Patent Owner overstates its significance. It establishes, at most, that Dr. Kenny did not expressly address this issue in his declaration (Exhibit 1003), but Dr. Kenny's opinion is that this would have been within the capability of a person of ordinary skill in the art to resolve. Based on the evidentiary record presented to us, we agree with Dr. Kenny. For example, Inokawa discloses a wrist-worn pulse sensor 1 having two emitters 21 and 23 in close proximity to each other. *See* Ex. 1008, Figs. 1–2. An artisan must be presumed to know something about the art apart from what the relied-upon references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Dr. Madisetti's testimony opposing Dr. Kenny's foregoing opinion is premised solely on Dr. Kenny's alleged failure to explain how issues that arise from adding a second emitter to Aizawa would have been solved; Dr. Madisetti does not provide any affirmative reason why these issues would have been difficult for a person of ordinary skill in the art to solve, in the context of Aizawa's device or wrist-worn pulse sensing devices in general. *See* Ex. 2004 ¶ 88.

Thus, we conclude a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, and would have had a reasonable expectation of success in doing so.

iii. "[b] a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprise at least four detectors"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses at least four detectors 22 that detect light that has been emitted by LED 21 and attenuated by body tissue. Pet. 24–25; *see, e.g.*, Ex. 1006 ¶ 27 (disclosing that light emitted from LED 21 "is reflected by a red corpuscle running through the artery 11 of the wrist 10 and . . . is detected by the plurality of photodetectors 22 so as to detect a pulse wave"); Ex. 1003 ¶¶ 82–83.

iv. "[c] a housing configured to house at least the plurality of detectors; and"

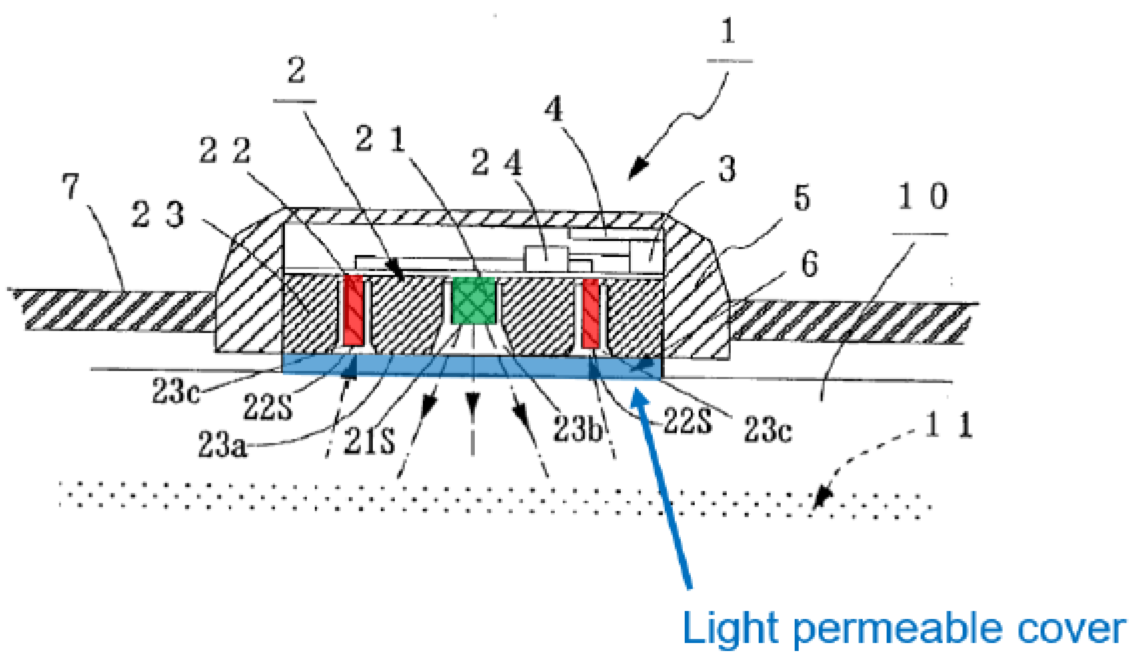
The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23, which houses the detectors in a portion of the housing. Pet. 25–26; *see, e.g.*, Ex. 1006 ¶ 23 ("holder 23 for storing . . . light emitting diode 21 and the photodetectors 22"), Figs. 1(a)–(b) (depicting holder 23 surrounding detectors 22).

v. "[d] a lens configured to be located between the tissue of the user and the plurality of detectors when the noninvasive optical physiological sensor is worn by the user, wherein the lens comprises a single outwardly protruding convex surface configured to cause tissue of the user to conform to at least a

> *portion of the single outwardly protruding convex surface when the noninvasive optical physiological sensor worn by the user and during operation of the noninvasive optical physiological sensor."*

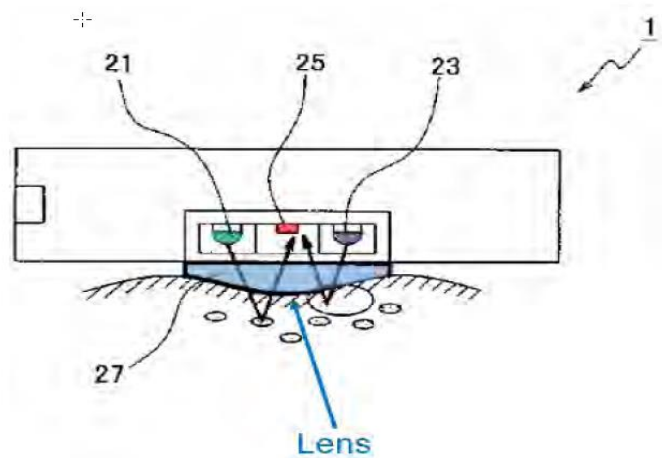
Petitioner's Contentions

With reference to an annotated version of Aizawa's Figure 1(b) (reproduced below), Petitioner contends that Aizawa "teaches a light permeable cover in the form of an acrylic transparent plate 6 (blue) that is mounted at the detection face 23a" of the sensor, between the user's tissue and the emitter/detector assembly. Pet. 8–9 (citing Ex. 1006, Fig. 1(b), ¶ 23); Ex. 1003 ¶¶ 55–56.



The figure above shows Petitioner's annotated version of Aizawa's Figure 1(b), in which transparent plate 6 is shaded in blue and identified as "Light permeable cover." Petitioner contends that beyond disclosing that the acrylic transparent plate "helps improve 'detection efficiency,' Aizawa does not provide much other detail, for instance regarding its shape." *Id.* at 14 (citing Ex. 1006 ¶ 30).

Petitioner reasons, however, that one of ordinary skill in the art would have "looked to Inokawa to enhance light collection efficiency, specifically by modifying the flat cover of Aizawa to include a lens." *Id.* at 14 (citing Ex. 1003 ¶¶ 87–91), 27–28 ("obvious to modify the flat acrylic plate of Aizawa . . . into a lens having a single outwardly protruding convex surface . . . to further Aizawa's objective of enhancing its light collection efficiency"). In that regard, Petitioner points to Inokawa's Figure 2. Petitioner's annotated version of that figure is reproduced below.

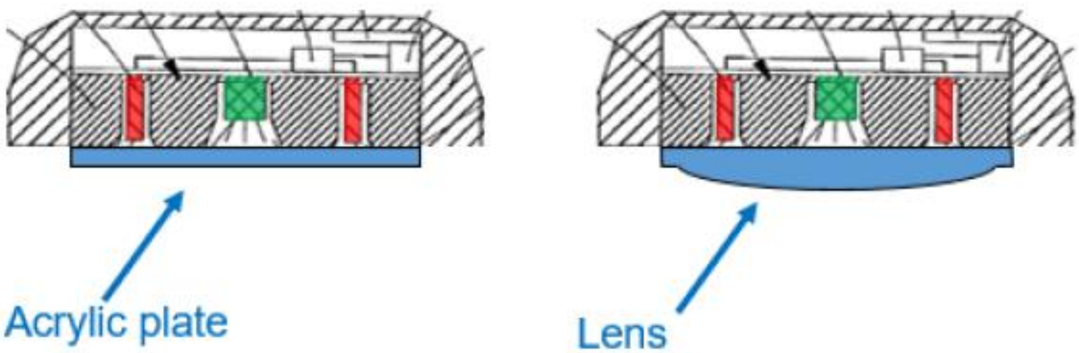


Id. at 14. Figure 2 above depicts Inokawa's lens 27 shaded in blue.

Petitioner expresses that Inokawa teaches that its cover may be either flat such that the surface is less prone to scratches or may be in the form of the lens shape shown above to "increase the light-gathering ability of the LED." *Id.* at 15–16 (quoting Ex. 1008 ¶¶ 15, 106); *see* Ex. 1003 ¶¶ 88–91. Petitioner contends that a person of ordinary skill in the art "making the design choice to prioritize improved improved light collection efficiency over reduced suseptibility to scratches could have readily modified Aizawa's cover to have a lens as per Inokawa." Pet. 16 (citing Ex. 1003 ¶ 91). Petitioner also contends that a skilled artisan would have had a reasonable expectation of success in combining those teachings. *Id.* at 15–16 (citing

Ex. 1003 ¶ 90). Petitioner adds that Aizawa's "transparent acrylic material . . . can be readily formed into a lens as in Inokawa." *Id.* at 16 (citing Ex. 1003 ¶ 91; Ex. 1009, 3:46–51, Fig. 1; Ex. 1023, Fig. 6, ¶¶ 22, 32, 35).

Petitioner provides annotated and modified versions of Aizawa's Figure 1(b) that depict the modification of the proposed combination, which are reproduced below. *Id.* at 15 (citing Ex. 1003 ¶ 89).



Petitioner's annotated figure on the left depicts the device with Aizawa's flat cover, wherein the annotated and modified figure on the right depicts the device resulting from the combination of Aizawa and Inokawa, in which a person of ordinary skill in the art would have replaced Aizawa's flat cover with a curved protrusion to "increase the light-gathering ability." *Id.* (quoting Ex. 1008 ¶ 15).

According to Petitioner, a person of ordinary skill in the art "would have understood how to implement Inokawa's lens[]in Aizawa's device with a reasonable expectation of success." Pet. 15–16 (citing Ex. 1003 ¶ 90). The shape of the modified cover in Dr. Kenny's illustration of the proposed modification above is similar to the shape of an LED lens illustrated in

Exhibit 1023 (hereafter "Nishikawa"),[5] referenced by Petitioner and Dr. Kenny in in connection with the proposed ground of unpatentability. *Compare* Pet. 15 (illustrating proposed modification), *with* Ex. 1023, Fig. 6, ¶¶ 3, 22, 30, 32, 35 (illustrating lens 50 used with LED 22, and discussing how to make the illustrated device); *see also* Pet. 16 (citing Ex. 1023), 51–52 (discussing teachings of Ex. 1023).

Petitioner also contends that, in the proposed modification, the convex surface of the lens will cause the user's tissue to conform because the rigid cover will be pressed against the user's skin with pressure. Pet. 28–30; Ex. 1003 ¶¶ 92–93, 98; Ex. 1006 ¶¶ 6, 23, 26, 30, 34; Ex. 1008, Fig. 2.

<u>Patent Owner's Arguments</u>

Patent Owner contends that the evidence does not support Petitioner's argument that it would have been obvious to modify Aizawa's cover to have a lens with an outwardly protruding convex surface, in order to improve detection efficiency by directing incoming light to Aizawa's photodetectors 22, with a reasonable expectation of success. PO Resp. 16–37; PO Sur-reply 2–13; Ex. 2004 ¶¶ 48–78.

According to Patent Owner, the evidence establishes that Petitioner's proposed modification would direct light *toward the center* of Aizawa's detector 1 where emitter 21 is located, rather than *toward the periphery* where detectors 22 are located. PO Resp. 16–24; Ex. 2004 ¶¶ 48–65. Thus, Patent Owner's view is that a person of ordinary skill in the art "would ***not*** have expected Inokawa's protruding surface to accomplish" the objective of enhancing light collection efficiency relied upon by Petitioner, because

[5] U.S. Patent Application Publication No. 2007/0145255 A1, filed Dec. 20, 2006, published June 28, 2007 (Ex. 1023).

Petitioner's proposed modification instead "would direct light ***away*** from the ***periphery***-located detectors" in Aizawa, the opposite result to Petitioner's contention. PO Resp. 20; Ex. 2004 ¶¶ 42–43, 48–57.

In support, Patent Owner points to Inokawa's Figure 2, in which two arrows illustrate light that passes through the convex protrusion of lens 27 toward the center of Inokawa's pulse sensor 1 where detector 25 is located. PO Resp. 17–18 (citing Ex. 1008 ¶ 58); Ex. 2004 ¶¶ 51–52. Patent Owner also points to the '266 patent's Figure 14B, which illustrates several light rays 1420, 1422 passing through a partially cylindrical protrusion 605 to be centrally focused on detector(s) 1410B. PO Resp. 18–19 (citing Ex. 1001, 35:57–60, 35:67–36:2; Ex. 2004 ¶¶ 53–54). Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, support Patent Owner's contentions in these regards. *See* PO Resp. 2–3, 16–18 (citing Ex. 2006, 83:15–84:2, 86:19–87:1, 108:21–109:14, 202:11–204:20).

Patent Owner also asserts that "Dr. Kenny admitted that the impact of Inokawa's convex lens would not be 'obvious' in the context of [the] different configuration of LEDs and detectors" presented by Aizawa. PO Resp. 20–21 (citing Ex. 2006, 87:2–6). For example, Patent Owner points out that "light reaching Aizawa's detectors must travel in an opposite direction from the light in Inokawa." *Id.* at 21–22 (Ex. 2004 ¶¶ 59–62). In addition, according to Patent Owner, "Petitioner's combination is particularly problematic because" Aizawa uses "small detectors [22] with small openings [of cavities 23c] surrounded by a ***large*** amount of ***opaque*** material." PO Resp. 22 (citing Ex. 1006, Fig. 1(a); Ex. 2004 ¶ 63). In support of its view, Patent Owner cites portions of Dr. Kenny's deposition testimony. *Id.* at 23 (citing Ex. 2006, 257:11–18). Patent Owner also argues that to account for this, "Petitioner is forced to increase the size of Aizawa's

detectors approximately five-fold and eliminate Aizawa's large opaque barriers—with no analysis or explanation of such changes or the[ir] impact." *Id.* at 23–24 (citing Ex. 2004 ¶ 65).

Patent Owner further argues that Dr. Kenny, during his deposition, attempted to evade the foregoing problems by "disclaim[ing] Petitioner's reasoning [for obviousness] and assert[ing] new and improper opinions" that undermine the reasoning provided in the Petition. PO Resp. 24. For example, Patent Owner asserts that Dr. Kenny's attempt to distinguish between the '266 patent's Figure 14B as illustrating a lens that condenses *collimated* light toward the center, as compared to Aizawa and Inokawa in which the lens focuses *diffuse* light reflected by the user's body; Patent Owner argues this is not persuasive and is not supported by record evidence. PO Resp. 24–26 (citing Ex. 2006, 170:9–171:5; Ex. 2007, 288:13–289:5, 294:17–298:10, 298:11–299:18, 423:7–424:18; Ex. 2004 ¶¶ 67–68). Patent Owner also objects to Dr. Kenny's testimony that, "while a protruding surface would generally direct more light to the center," it "would also capture some light that otherwise would not be captured" by Aizawa's detectors 22, as lacking evidentiary support and relying on impermissible hindsight. PO Resp. 28–29 (citing Ex. 2004 ¶ 69–71; Ex. 2006, 204:21–206:5, 206:22–208:1; Ex. 2007, 294:17–298:10).

Patent Owner moreover asserts that "Dr. Kenny repeatedly distanced himself from his own similar combination" of Aizawa and Inokawa by refusing to talk about the specific shape, size, material, and dimensional tolerances of the combination, so, in Patent Owner's view, his testimony falls short because it demonstrates at most only that the references could have been combined. *Id.* at 2–3, 27–31 (citing, e.g., Ex. 2004 ¶¶ 71–73; Ex. 2006, 51:14–52:16, 75:20–77:2, 91:9–92:13, 96:20–21, 97:11–21,

100:17–101:18, 132:10–18, 154:4–7, 164:8–16, 189:11–190:3; Ex. 2007, 308:12–309:8, 310:18–311:9, 318:3–6, 324:21–325:19, 333:20–335:4).

Indeed, according to Patent Owner, because ordinary skill does not require specific education or experience with optics or optical physiological monitors (*see supra* Section II.C), "[i]t strains credibility that a [person of ordinary skill in the art] . . . could balance all of the factors Dr. Kenny identified" to reach the claimed invention. PO Resp. 31–32. Patent Owner relies on Dr. Kenny's testimony as establishing the complexity of designing optical physiological sensors. *Id.* at 3–4, 32–33 (citing Ex. 2006, 86:19–87:6; Ex. 2007, 331:19–332:11, 336:11–337:15). Patent Owner concludes Petitioner has failed to establish a reasonable expectation of success because Dr. Kenny's testimony "focuses almost entirely on manufacturing." *Id.* at 33 (citing Ex. 1003 ¶ 91; Ex. 2004 ¶ 75).

Patent Owner moreover asserts Petitioner errs in relying on Nishikawa as supporting the unpatentability of claim 1, because Nishikawa is "not identified as part of" the ground, which instead "includes only two references," Aizawa and Inokawa. PO Resp. 34 (citing Pet. 14; Ex. 1003 ¶¶ 86–91); *id.* at 35–36 (citing 35 U.S.C. § 312(a)(3); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)). Patent Owner asserts Dr. Kenny "relies heavily" on Nishikawa, particularly "to inform the specific shape of the cover in his similar combination, which is found nowhere in Aizawa and Inokawa." *Id.* at 34–35 (citing Ex. 2004 ¶¶ 76–77; Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12).

Furthermore, in Patent Owner's view, Dr. Kenny's reliance on Nishikawa "make[s] no sense" because "Nishikawa's device is not a physiological sensor" but rather is "an encapsulated LED" that "directs

outgoing light through the encapsulation material and thus focuses on the emission of light, not the detection of an optical signal." PO Resp. 36 (citing Ex. 1023, code (57), ¶¶ 3, 32, 35; Ex. 2004 ¶ 78). Patent Owner contrasts such disclosure with Aizawa and Inokawa, both of which "detect[] ***incoming*** light that passes through the cover and reaches the detectors," and which have a "drastically" smaller scale than Nishikawa's LEDs. *Id.* at 36–37 (citing Ex. 1008, Fig. 2; Ex. 2004 ¶ 78).

<u>Petitioner's Reply</u>

In reply, Petitioner insists "Inokawa's lens enhances the light-gathering ability of Aizawa," which would have motivated an ordinarily skilled artisan "to incorporate 'an Inokawa-like lens [having a protrusion] into the cover of Aizawa to increase the light collection efficiency.'" Pet. Reply 2–3 (citing Pet. 13–15; Ex. 1003 ¶¶ 86–89; Ex. 1008, Fig. 2, ¶¶ 15, 58). Petitioner dismisses Patent Owner's and Dr. Madisetti's opposition as being "misinformed" because a person of ordinary skill in the art "would understand that Inokawa's lens generally improves 'light concentration at pretty much all of the locations under the curvature of the lens,' as opposed to only at a single point at the center." *Id.* at 3 (quoting Ex. 2006, 164:8–16); Ex. 1047 ¶¶ 7–9.

For example, Petitioner contends that Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility," by which "a ray going from P to S will trace the same route as one from S to P." Pet. Reply 4

(underlining omitted) (citing, e.g., Ex. 1052,[6] 84, 87–92); Ex. 1047 ¶¶ 10–22. Petitioner contends that Dr. Madisetti was evasive when he was asked to apply the reversibility principle to the combination of Aizawa and Inokawa in this case. Pet. Reply 6 (citing Ex. 1034, 89:12–19). Petitioner further contends that, "based at least on the principle of reversibility," one of ordinary skill in the art "would have understood that both configurations of LEDs and detectors—i.e., with the LED at the center as in Aizawa or with the detector at the center as in Inokawa—would similarly benefit from the enhanced light-gathering ability of an Inokawa-like lens." *Id.* at 9 (citing Ex. 1047 ¶ 22).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue in the user's wrist, to be received by detectors in either Aizawa's or Inokawa's pulse sensor, will be "scattered" and "diffuse" and, therefore, will approach the detectors "from various random directions and angles." Pet. Reply 9–10, 13 (annotating Inokawa's Fig. 2 to illustrate the cause and nature of the back-scattering); Ex. 1047 ¶¶ 23–26. This scattered and diffuse light, according to Petitioner, means that Inokawa's "lens cannot focus all incoming light toward the sensor's center," as Patent Owner would have it. Pet. Reply 9 (citing Ex. 1047 ¶ 23; Ex. 2006, 163:12–164:2). Petitioner asserts this is due to

---

[6] Eugene Hecht, *Optics* (2nd ed. 1990). It is apparent that the page numbering identified by Petitioner for Exhibit 1052 refers to the documents native page numbering and not the page numbering of the exhibit appearing at the bottom, middle of each page. For clarity and consistency, in this Decision, we also refer to the same page numbering as Petitioner for Exhibit 1052.

Snell's law, and provides several illustrations to illustrate why. *Id.* at 9–15 (citing, e.g., Ex. 1047 ¶¶ 23–34).

Due to the random nature of this scattered light, Petitioner explains that one of ordinary skill in the art would have understood that a convex cover "provides a slight refracting effect, such that light rays that may have missed the detection area are instead directed toward that area." Pet. Reply 10 (citing Ex. 1047 ¶¶ 25–26). Petitioner applies this understanding to Aizawa, and contends that using a lens with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source. *Id.*

Moreover, Petitioner dismisses the applicability of Figure 14B of the '266 patent as illustrating the operation of a *transmittance*-type of sensor that measures the attenuation of collimated light transmitted through the user's body tissue, rather than the *reflectance*-type sensor of Aizawa. *Id.* at 11–13 (citing, e.g., Ex. 1001, 35:65–67; Ex. 1047 ¶¶ 27–31).

Petitioner further maintains that Patent Owner's argument that Petitioner's illustrations of the light-focusing properties of a convex lens discussed in the Petition filed in IPR2020-01520 (Ex. 2019, 39) and relied upon by Dr. Kenny (Ex. 2020, 119–120) does not demonstrate "that a convex lens directs all light to the center." Pet. Reply 15 (citing PO Resp. 16–18). Petitioner contends these illustrations, instead, "are merely simplified diagrams included to illustrate . . . one example scenario (based on just one ray and one corpuscle) where a light permeable cover can 'reduce a mean path length of light traveling to the at least four detectors'" as recited in a claim challenged in that proceeding. *Id.* (citing, e.g., Ex. 1047 ¶ 34).

Patent Owner's Sur-reply

Patent Owner asserts that Petitioner's Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *See, e.g.*, PO Sur-reply 1 ("new optics theories" and "new arguments"), 2, 6, 7, 9, 10, 12, 13.

Patent Owner also contends that Petitioner mischaracterizes Patent Owner's position, which is not that Inokawa's lens with a convex protrusion "would direct '***all***' light 'only at a ***single point*** at the center'" of the sensor. *Id.* at 2, n.2 (quoting Pet. Reply 3; citing, e.g., Ex. 2027, 63:7–64:6, 94:20–96:1, 96:18–97:7). Patent Owner's position, rather, is that Inokawa's lens condenses more light (not necessarily all light) "***towards the center*** of the sensor" as compared to a flat surface. *Id.* at 2 (quoting PO Resp. 19; citing, e.g., Ex. 2004 ¶¶ 34, 43, 49, 51–52, 54–55, 67).

Patent Owner moreover asserts "[t]here can be no legitimate dispute that a convex surface directs light centrally (and away from the periphery)." PO Sur-reply 3–6 (citing PO Resp. 16–19; Ex. 2006, 164:8–16, 166:10–17, 170:22–171:5; Ex. 2020 ¶¶ 119, 200; Ex. 2027, 181:9–182:5). Patent Owner contends that Petitioner's argument "that Inokawa would improve light-gathering at all locations, ***regardless*** of the location of the LEDs and detectors" is belied by Dr. Kenny's testimony that "Inokawa's benefit would ***not*** be clear if Inokawa's LEDs and detectors were moved" and "confirmed that a convex surface would direct light toward the center of the underlying sensor." *Id.* at 5–6 (citing Pet. Reply 3–4; Ex. 2006, 86:19–87:6, 202:11–204:20).

Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes ideal conditions that are not present when tissue scatters and absorbs light." PO Sur-reply 6–8 (citing

Ex. 2027, 17:12–19:2, 29:11–30:7, 31:8–32:3, 38:17–42:6, 207:9–209:21, 210:8–211:6). The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether a convex surface—***as compared with a flat surface***—would collect and focus additional light on Aizawa's peripherally located detectors." *Id.* at 8–9 (citing Ex. 2027, 212:3–14).

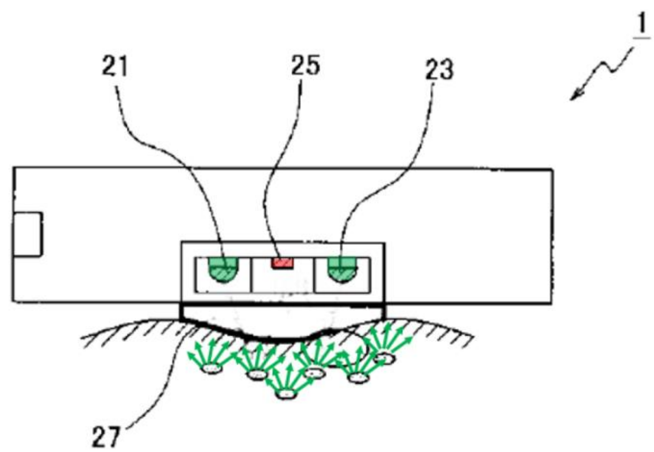
Patent Owner also argues that Petitioner's position that a convex cover will provide a "***slight***" refracting effect, "directly undermines Petitioner's provided ***motivation*** to combine," i.e., to enhance light collection efficiency. *Id.* at 10–11.

Analysis

Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's view that it would have been obvious to modify Aizawa's cover 6 to include a lens with a single outwardly protruding convex surface like that taught in Inokawa, in order to increase the amount of backscattered light that will be received by Aizawa's four peripheral detectors 22, as compared with Aizawa's existing flat cover.

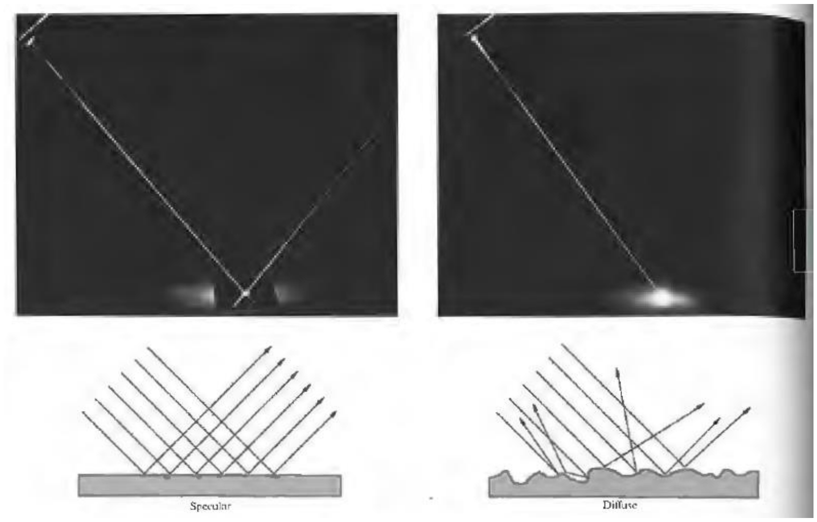
It is clear that Aizawa's and Inokawa's pulse sensors both gather data by emitting light into the user's wrist tissue, and collecting light that reflects back to the sensor from the user's tissue. *See, e.g.*, Ex. 1006, Figs. 1(b), 2 (sensor 2 has emitter 21 and four detectors 22, all facing a user's wrist 10); Ex. 1008, Figs. 1, 2 (sensor 1 has two emitters 21, 23 and one detector (photodiode 25), all facing the user's wrist when held in place by wristband 5). Dr. Kenny testifies, and Patent Owner agrees, that the

reflection of this light by the user's wrist tissue randomizes the propagation direction of the reflected light rays. *See* Ex. 1047 ¶¶ 12, 14–17, 23; Ex. 2020 ¶ 128; PO Sur-reply 7 ("Even Petitioner admits that tissue randomly scatters and absorbs light rays . . . ."). This reflection principle is illustrated by Dr. Kenny's annotations to Inokawa's Figure 2 reproduced below:



Here, Dr. Kenny has modified Inokawa's Figure 2 (1) by removing two black arrows, (2) by coloring Inokawa's light detector in red and Inokawa's two light emitters in green, and (3) by adding several green arrows to illustrate the various directions that light rays may be directed after impinging on and reflecting off different tissues in the user's wrist. Ex. 1047 ¶ 32.

This randomized direction of reflected light rays results in backscattered light that is diffuse, rather than collimated, in nature. Figure 4.12 of Exhibit 1052 illustrates the difference between diffuse and collimated light, and is reproduced below:



This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1052, 87–88. The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*

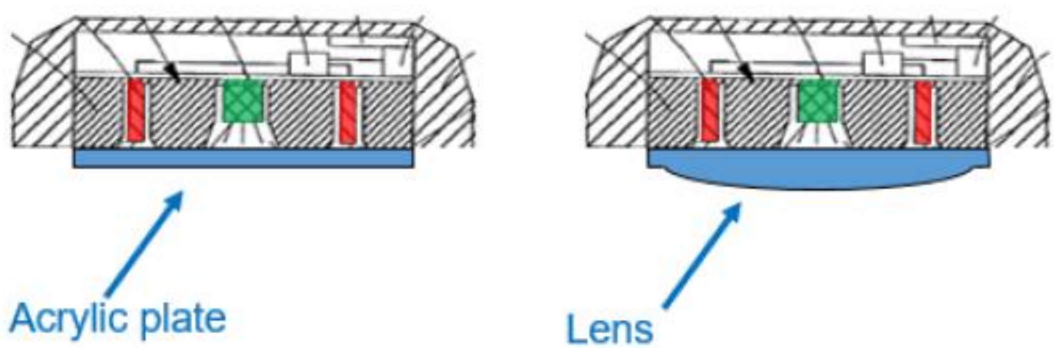
This diffuse nature of the light reflected from the user's wrist tissue, which both Aizawa and Inokawa aim to collect to generate pulse data, suggests that a lens might be useful to increase the amount of collected light and thereby increase the reliability of the pulse data generated using the collected light. Indeed, that is taught by Inokawa. Inokawa describes using its lens 27 to "increase the light-gathering ability" of Inokawa's light photodiode or detector 25.[7] Ex. 1008 ¶¶ 15, 58. Furthermore, there is also no dispute that Inokawa's lens 27 is understood to be shaped to include a

---

[7] Although Inokawa refers to the "LED" such as emitters 21, 23 in that regard (Ex. 1008 ¶ 15), rather than photodiode 25, it is undisputed that photodiode 25 is the only component of Inokawa's sensor 1 that gathers light.

single convex protruding surface. *See, e.g.*, Ex. 1003 ¶¶ 87–88 (characterizing Inokawa as teachings a "convex protrusion that acts as a lens"); PO Resp. 1 (describing Inokawa as teaching a "convex lens"). Thus, Inokawa demonstrates that it was known in the art to use a lens comprising a protrusion to focus diffuse light reflected from body tissue on to the light detecting elements of a wrist-worn pulse sensor, and to increase the light gathered by the sensor thereby improving the device's calculation of the user's pulse.

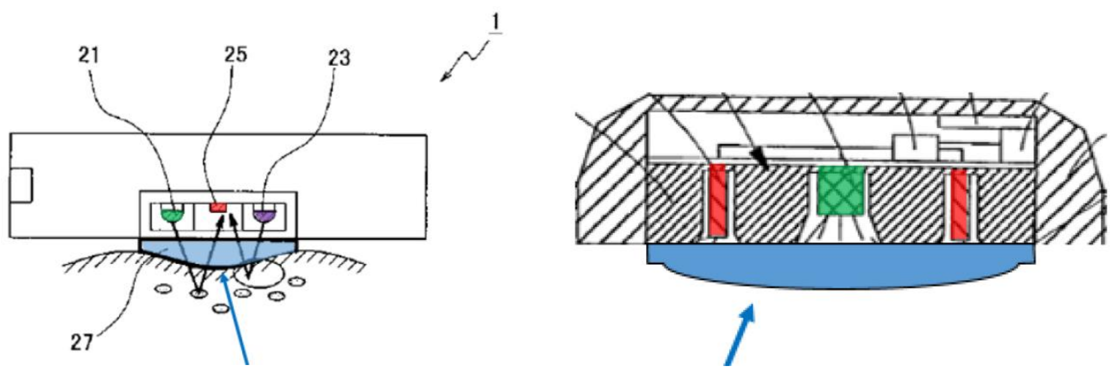
A preponderance of the evidence supports Petitioner's view that it would have been obvious for a person of ordinary skill in the art to apply Inokawa's lens technology to Aizawa's wrist-worn pulse sensor, to similarly improve its light collection as compared to Aizawa's existing flat cover. That is illustrated by the following illustrations provided by Dr. Kenny:



The illustration at left modifies Aizawa's Figure 1(b) to color Aizawa's emitter in green, its detectors in red, and Aizawa's existing flat cover in blue; the illustration on the right includes Aizawa's Figure 1(b) with the same color coding, but wherein the flat cover is modified to incorporate a convex protrusion that covers Aizawa's peripheral light detectors and central light emitter. *See* Ex. 1003 ¶ 89. We are persuaded by Dr. Kenny's testimony that Snell's law indicates that "light rays that may have otherwise missed the detection area are instead directed toward that area as they pass

through the interface provided by the cover," and is especially true "in configurations like Aizawa's in which light detectors are arranged symmetrically about a central light source, so as to enable backscattered light to be detected within a circular active detection area surrounding that source." Ex. 1047 ¶ 26; *see also id.* ¶¶ 23–26.

Patent Owner correctly notes that Inokawa's single detector 25 is located in the central portion of Inokawa's sensor 1, whereas Aizawa's four detectors 22 are located towards the periphery of Aizawa's sensor 2. *Compare* Ex. 1008, Fig. 2, *with* Ex. 1006, Figs. 1(a)–1(b). Nevertheless, Petitioner's proposed modification of Aizawa takes that arrangement into account, as can be seen by the following comparison between Inokawa's sensor and Petitioner's proposed modification of Aizawa's sensor:



The illustration at left annotates Inokawa's Figure 2 to identify the central detector in red and the lens in blue (*see* Ex. 1003 ¶ 87), and the illustration at right annotates Petitioner's proposed modification of Aizawa to illustrate the peripheral detectors in red and the lens in blue (*see id.* ¶ 89). As can be seen, the lenses are not identical. In Inokawa the lens's curvature is most pronounced at the center of the lens near the central detector, and in the proposed modification to Aizawa, the lens's curvature is most pronounced at the edges of the lens near the peripheral detectors. Thus, Dr. Kenny's proposed modification of Aizawa takes Inokawa's general teaching of using

a convex protrusion lens to increase the amount of incoming light directed to a light detector, and applies it to the light detectors of Aizawa. *See, e.g.*, Ex. 1003 ¶ 88 ("[B]ecause the path of light is reversible, the light collection function of Inokawa's lens would work the same way regardless of whether light is emitted toward the center (and detected by a centrally located photodiode) or emitted away from the center (and detected by a peripherally located photodiode)."), 90 ("That is, depending on the desired objective of the user (e.g., less scratches or improved light-gathering), the shape of the cover can be readily modified."), 91 ("[T]o achieve the goal of improving light collection efficiency, which both Aizawa and Inokawa share, a [person of ordinary skill in the art] would have been able to, with a reasonable expectation of success, modify Aizawa's light permeable cover to include a lens as taught by Inokawa."); Ex. 1047 ¶¶ 7–34.

We are cognizant of Patent Owner's contention that Petitioner's ground "improperly" relies upon a reference, Nishikawa, that was not identified as a part of the ground of unpatentability. PO Resp. 34. As Patent Owner observes, Dr. Kenny characterizes his testimony as being "***inspired*** by" or "motivated" in part based on Nishikawa's disclosure when it comes to the shape of a convex lens. *See, e.g.*, PO Resp. 34–35 (citing, e.g., Ex. 2007, 364:2–13; Ex. 2008, 73:8–12). We, however, disagree with Patent Owner that any impropriety arises from Dr. Kenny's contemplation of the teachings of Nishikawa in connection with the shape of a lens for a physiological sensor. The nature of Petitioner's and Dr. Kenny's consideration of Nishikawa is explained in cited portions of Dr. Kenny's declaration, even if Nishikawa is not listed as a third reference in the identification of the ground. *See* Ex. 1003 ¶ 91 ("[M]any prior art references of this period, such as Nishikawa (shown below) demonstrate exactly how

such a lens shape [as taught by Inokawa] may be incorporated into a molded cover."); Pet. 16–17. Indeed, it follows readily from the Petition that a skilled artisan would have appreciated that Nishikawa's teachings provide insight as to how "the transparent acrylic material used to make Aizawa's plate can be readily formed into a lens as in Inokawa." Pet. 16. Nishikawa describes how its "lens unit 50" can be a transparent resin formed in the shape illustrated in Figure 6 by injection molding. Ex. 1023 ¶¶ 22, 32, 35. Dr. Kenny also explains that Nishikawa's lens shape design "is intended to provide curvature in the lens where it can do the most good and otherwise try to avoid excess use of material in order to create curvature in locations where it wouldn't do any good." Ex. 2006, 179:21–180:13.

Moreover, we observe that a rejection based on obviousness "require[s] an analysis that reads the prior art in context, taking account of 'demands known to the design community,' 'the background knowledge possessed by a person having ordinary skill in the art,' and 'the inferences and creative steps that a person of ordinary skill in the art would employ.'" *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (quoting *KSR*, 550 U.S. at 418). Furthermore, record evidence can be useful to "demonstrate the knowledge and perspective one of ordinary skill in the art." *Id.*; *see also Ariosa Diagnostics v. Verinata Health Inc.*, 805 F.3d 1359, 1365 (Fed. Cir. 2015) ("Art can legitimately serve to document the knowledge that skill artisan would bring to bear in reading the prior art identified as producing obviousness.").

As noted above, Dr. Kenny makes clear that his view as to obviousness of the claims of the '266 patent was "inspired by" or "motivated" in part by Nishikawa's teachings as to shapes generally known to those in the art of manufacturing a lens. *See, e.g.*, Ex. 2007, 364:2–13;

Ex. 2008, 73:12–21. We conclude that the record establishes that Nishikawa's teachings are representative of background knowledge of one of ordinary skill in the art and provide context and perspective of a skilled artisan as to the type of shapes available for a convex protruding surface, such as that disclosed in Inokawa. That Dr. Kenny considered record evidence cited in the Petition as informing his view of what a skilled artisan would understand as to known types of lens shapes does not establish, in our view, any impropriety as part of that ground.

Patent Owner additionally asserts, and Dr. Madisetti testifies, that Petitioner's combination of Aizawa and Inokawa is "problematic" because it overlooks the "small" size of Aizawa's detectors 22 and the openings or cavities 23c in which they are housed. *See* PO Resp. 22 (citing Ex. 1006, Fig. 1(a); Ex. 2004 ¶ 63). Patent Owner, however, does not articulate what significance the size of Aizawa's detector components have in the obviousness evaluation based on the teachings of the prior art.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new arguments and evidence that should have been first presented in the Petition. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa's device. *See, e.g.*, Pet. 13–17. Patent Owner, in its Response, then challenged that contention with several arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleged. *See, e.g.*, PO Resp. 16–37. In its Reply, Petitioner provided arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See*

PTAB Consolidated Trial Practice Guide (Nov. 2019),[8] 73 ("A party also may submit rebuttal evidence in support of its reply."). The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 13–17, *with* Pet. Reply 2–15.

Patent Owner finally argues that a conclusion of obviousness "strains credibility" because the level of ordinary skill in the art (*see supra* Section II.C) does not require specific education or experience with optics or optical physiological monitors. *See, e.g.*, PO Resp. 31–32. We disagree. Concerning motivation, an ordinarily skilled artisan would have readily appreciated from the record at hand that: (1) Aizawa's detector 1 operates by gathering light data with its photodetectors 22; (2) a lens was known to focus the light on photodetectors; and (3) optical lenses may be formed by providing a convex protrusion in the lens to focus light. Indeed, Inokawa discloses such utility, function, and structure as a part of its convex lens. *See, e.g.*, Ex. 1008 ¶¶ 15, 58, Fig. 2. We are persuaded that a person of ordinary skill in the art would have understood these general concepts of optics.

Concerning reasonable expectation of success, we rely on Dr. Kenny's testimony that a person of ordinary skill in the art would have "would have sought to incorporate a convex, lens structure as in Inokawa into Aizawa's acrylic plate to thereby increase light collection efficiency, in turn leading to more reliable pulse wave detection," "would have further understood *how* to" do so, "depending on the desired objective of the user,"

[8] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

and would have enjoyed a reasonable expectation of success in doing so. Ex. 1003 ¶¶ 88, 90–91; Ex. 2006, 179:21–180:13, 202:11–20.

Thus, we conclude that one of ordinary skill in the art would have had adequate reason to replace Aizawa's flat cover 6 with a cover comprising a convex protrusion, to improve light detection efficiency, and would have had a reasonable expectation of success in doing so.

vi. Summary

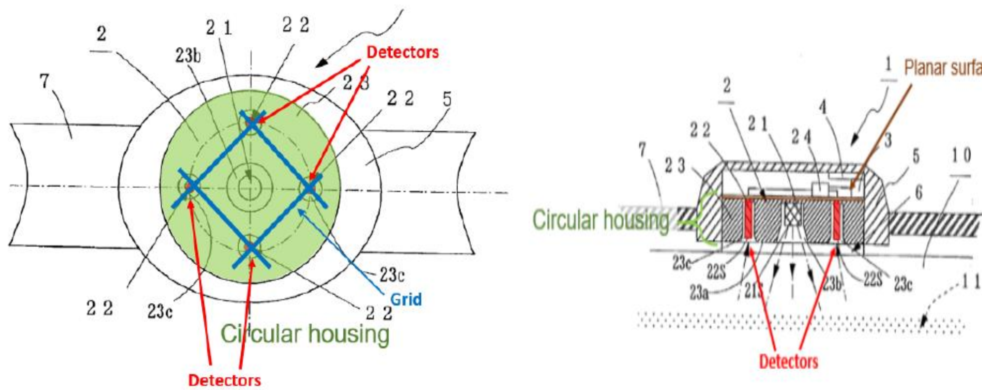
For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

4. Independent Claim 9

Independent claim 9 consists of limitations that are substantially similar to limitations [a]–[d] of claim 1. *Compare* Ex. 1001, 44:37–54, *with id.* at 45:13–23 (reciting "a housing" as opposed to "a circular housing including a planar surface"; "at least four detectors" as opposed to "at least four detectors arranged on the planar surface" and "the four detectors are arranged in a grid pattern"; "a lens" as opposed to "a lens forming a cover" and omitting details of the lens' location; the sensor is "worn by the user" as compared to omitting details regarding user wear).

In asserting that claim 9 also would have been obvious over the combined teachings of Aizawa and Inokawa, Petitioner refers to the same arguments presented as to claim 1 (Pet. 35–36, 39 ("*See supra* Ground 1A")) and also presents additional arguments corresponding to the claimed "circular housing," "planar surface," and "grid pattern" limitations (Pet. 36–39). Specifically, Petitioner presents modified and annotated Figures 1(a)

and (1b) of Aizawa (reproduced below) to demonstrate the claimed circular housing and planar surface.



Annotated Figure 1(a) (left) depicts pulse wave sensor 2 comprising holder 23 with detectors 22 arranged in a standard north, south, east, west grid pattern (depicted in blue). Pet. 38. The circular shape of the holder is highlighted in green. *Id*. Annotated Figure 1(b) (right) depicts pulse wave sensor 2 comprising holder 23 (labeled in green text as "Circular housing"). Pet. 36. The holder is adjacent to a surface, highlighted in brown, that Petitioner equates to the claimed "planar surface." *Id*.

Patent Owner does not present any argument for these claims other than those we have already considered with respect to independent claim 1 and our claim construction analysis above. PO Resp. 12–43.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 9 would have been obvious over the cited combination of references. *See supra* II.D.3.i–v; Ex. 1003 ¶¶ 106–113.

5. *Dependent Claims 2–6, 8, 10–16, 18, and 19*

Petitioner presents undisputed contentions that claims 2–6, 8, 10–16, 18, and 19, which depend directly or indirectly from independent claim 1 or

9, are unpatentable over the combined teachings of Aizawa and Inokawa, and provides arguments explaining how the references teach the limitations of these claims. Pet. 30–35, 39–44; Ex. 1003 ¶¶ 94–105, 114–124.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 43 ("The Petition fails to establish that independent claims 1 and 9 would have been obvious . . . and thus fails to establish obviousness as to any of the challenged dependent claims.") (citing Ex. 2004 ¶ 89).

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–6, 8, 10–16, 18, and 19 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

E. Obviousness over the Combined Teachings of Mendelson-1988 and Inokawa

Petitioner contends that claims 1–6, 8–16, 18, and 19 of the '266 patent would have been obvious over the combined teachings of Mendelson-1988 and Inokawa. Pet. 47–71.

1. Overview of Mendelson-1988 (Ex. 1015)

Mendelson-1988 discloses a pulse oximeter, with an optical reflectance sensor suitable for noninvasive monitoring of a user's arterial hemoglobin oxygen saturation (SpO_2), via the user's forehead. *See* Ex. 1015, 167 (title & abstract). Figure 2 is reproduced below:

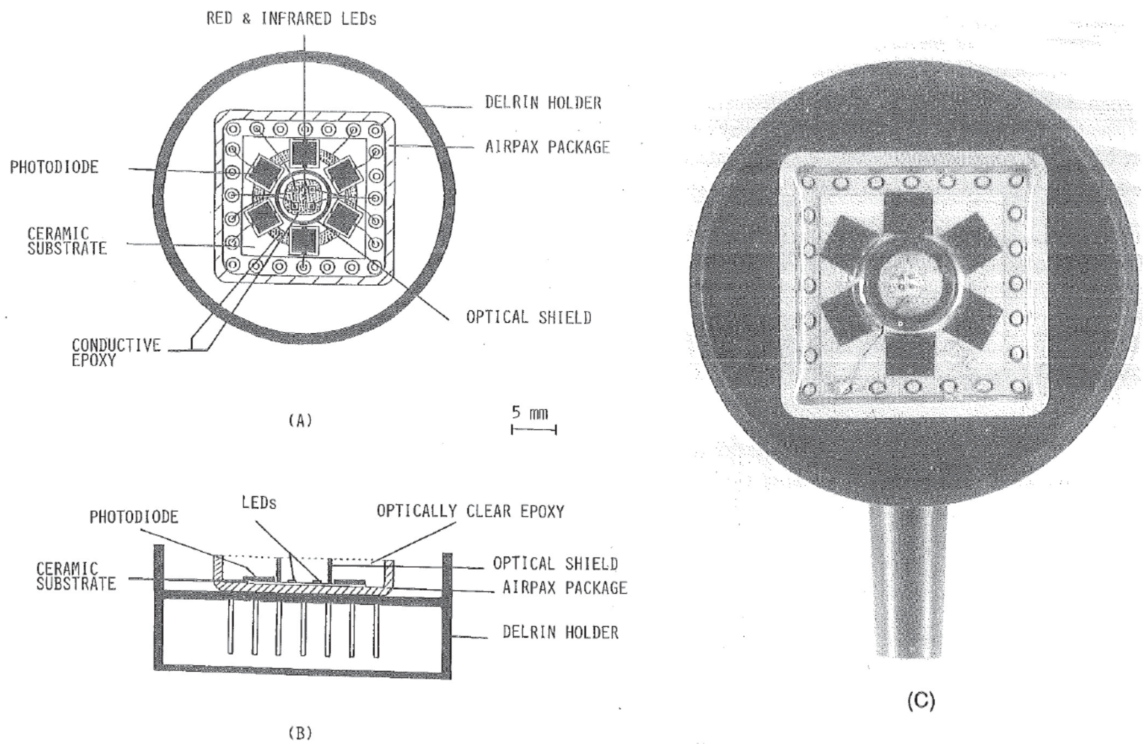


Figure 2 illustrates the sensor of Mendelson-1988, including: (A) a top view diagram; (B) a side view diagram; and (C) a photograph. *Id.* at 169.

The sensor includes two red LEDs and two infrared LEDs for emitting light into the user's tissue, and six photodiodes "arranged symmetrically in a hexagonal configuration" surrounding the four emitters, to detect light reflected back to the sensor from the user's tissue. *Id.* at 168 ("SENSOR DESIGN"). The user's "SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms." *Id.* at 167. "To minimize the amount of light transmission and reflection between the LEDs and the photodiodes within the sensor, a ring-shaped, optically opaque shield of black Delrin . . . was placed between the LEDs and the photodiode chips." *Id.* at 168 (col. 2). "The optical components were encapsulated inside the package using optically clear adhesive." *Id.* "The microelectronic package was mounted inside a black Delrin housing." *Id.*

2. Independent Claim 1

i. "A noninvasive optical physiological sensor comprising"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses a noninvasive optical physiological sensor, i.e., an "optical reflectance sensor" that monitors "arterial hemoglobin oxygen saturation [SpO_2]," a physiological parameter of the wearer. Pet. 52; *see, e.g.*, Ex. 1015, Abstract, 167, 172; Ex. 1003 ¶ 130.

ii. "[a] a plurality of emitters configured to emit light into tissue of a user"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses two red LEDs and two infrared LEDs that emit light into user tissue. Pet. 52–53; *see, e.g.*, Ex. 1015, 168 ("The optical reflectance sensor used in this study consists of two red (peak emission wavelength: 660 nm) and two infrared (peak emission wavelength: 930 nm) LED chips.")), Fig. 2(a); Ex. 1003 ¶ 131.

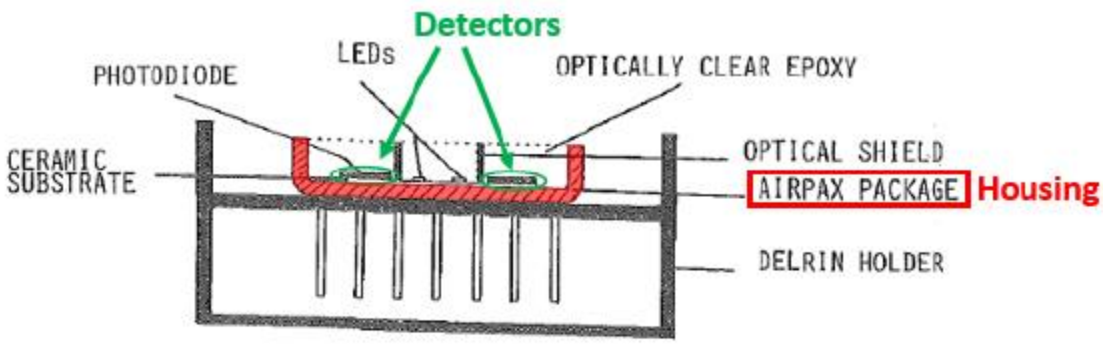
iii. "[b] a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprise at least four detectors"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1998 discloses "six silicon photodiodes . . . arranged symmetrically in a hexagonal configuration" on the sensor. Pet. 53–54; *see, e.g.*, Ex. 1015, 168–169, Figs. 2(A)–(B). Mendelson-1998 discloses that the photodiodes output "current pulses" indicative of a physiological parameter of the wearer in response to light emitted by the emitters and reflected from the skin. Pet.52; *see, e.g.*, Ex. 1015, 167 ("SpO_2 can be calculated from the

ratio of the reflected red and infrared photoplethysmograms."); Ex. 1003 ¶ 132.

iv. "[c] a housing configured to house at least the plurality of detectors"

The cited evidence supports Petitioner's contention that Mendelson-1988 discloses an AIRPAX package, i.e., a housing in which the detectors are located. Pet. 54; Ex. 1015, 168. Petitioner's annotated version of Mendelson-1988's Figures 2B is reproduced below.



Pet. 54. The modified figure depicts a side view of Mendelson-1988's sensor with a housing (depicted in red) in which the detectors (depicted in green) are located. *Id.*; Ex. 1003 ¶ 133.

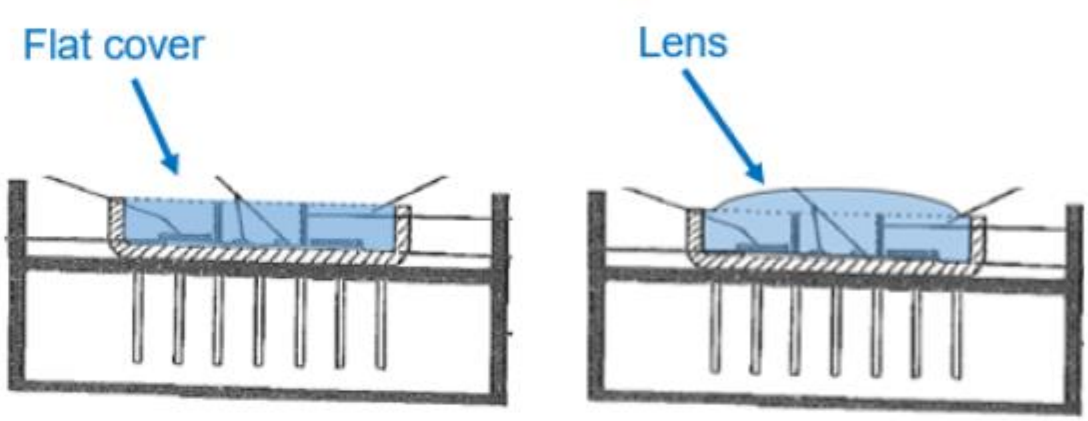
v. "[d] a lens configured to be located between the tissue of the user and the plurality of detectors when the noninvasive optical physiological sensor is worn by the user, wherein the lens comprises a single outwardly protruding convex surface configured to cause tissue of the user to conform to at least a portion of the single outwardly protruding convex surface when the noninvasive optical physiological

> *sensor worn by the user and during operation of the noninvasive optical physiological sensor."*

Petitioner's Contentions

Petitioner contends that Mendelson-1988's sensor discloses a light permeable cover, i.e., the "OPTICALLY CLEAR EPOXY" in Figure 2B, that covers the detectors and is located between the user's tissue and the detectors when worn. Pet. 47–48, 55–56; Ex. 1003 ¶¶ 67, 134–143. Petitioner states that Mendelson-1998 does not provide further details, such as the "precise shape of this layer's interface with the skin." Pet. 48–49; Ex. 1003 ¶ 135. As discussed above in Section II.D.3, Petitioner contends that Inokawa's sensor includes lens 27 positioned over light detector 25. Pet. 49. Petitioner reasons that an ordinarily skilled artisan would have been motivated, with a reasonable expectation of success, to modify Mendelson-1988's optical SpO_2 sensor, in light of Inokawa's optical pulse sensor, by adding a lens with a single outwardly protruding convex surface to Mendelson-1988's cover to improve the sensor's light detection efficiency. *Id.* at 49–50.

Dr. Kenny provides the following illustrations to portray the proposed modification of Mendelson-1988's sensor (Ex. 1003 ¶¶ 138–139):



At the left, Dr. Kenny has excerpted and annotated Mendelson-1988's Figure 2B, to identify the pre-existing cover (colored blue) which covers the light emitters and detectors. *See id.* At the right, Dr. Kenny has illustrated the device resulting from the proposed modification of the cover to have a single convex protrusion (also colored blue). *See id.*

Petitioner adds that a person of ordinary skill in the art would have had a reasonable expectation of success in implementing Inokawa's lens structure in Mendelson-1998, and that the modification would have "require[d] only routine knowledge of sensor design and assembly." Pet. 51; Ex. 1003 ¶ 140. For example, Petitioner contends that prior art such as Nishikawa[9] demonstrates that "molding clear epoxy, as in Mendelson-1988, into a lens was well understood." Pet. 51 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35; Ex. 1003 ¶ 141). Indeed, Petitioner notes that Mendelson-1998 and Nishikawa utilize the same material, which "can have the same index of refraction, and, as such, the interface between the encapsulation portion and the lens portion will not adversely affect the optical performance of the modified system." *Id.* at 51–52 (citing Ex. 1023 ¶ 37; Ex. 1003 ¶ 142).

Finally, Petitioner contends that "[a]ttaching a rigid device," as suggested by the proposed combination of Mendelson-1998 and Inokawa, "in such a manner will cause at least some deformation of the tissue to occur because the skin is more pliable than the cover," such that the modified sensor and lens "acts to further deform the tissue of the user around the convex surface of the lens when the device is pressed against the tissue." Pet. 56; Ex. 1003 ¶ 143.

[9] U.S. Patent Application Publication No. 2007/0145255 A1, filed Dec. 20, 2006, published June 28, 2007 (Ex. 1023).

Patent Owner's Arguments

Patent Owner is of the view that Petitioner has not met its burden to demonstrate the obviousness of modifying Mendelson-1988's sensor in light of Inokawa to have a protrusion, based on substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. *See* PO Resp. 47–51; Ex. 2004 ¶¶ 98–109; *supra* Section II.D.3.v. For example, Patent Owner argues that Mendelson-1988, like Aizawa, provides central emitters surrounded by several peripherally located detectors. *Compare* Ex. 1015, 169 (Fig. 2) (showing four central LEDs surrounded by six photodiodes), *with* Ex. 1006, Figs. 1(a)–1(b) (showing one central LED 21 surrounded by four photodetectors 22); PO Resp. 47. Given this arrangement, Patent Owner reiterates its argument that the proposed combination in view of Inokawa would direct light away from the peripheral detectors, and toward the center of the sensor, thereby diminishing the received signal. PO Resp. 49–51.

Additionally, and as discussed above in the context of combining Aizawa and Inokawa, Patent Owner argues that Petitioner improperly relies upon Nishikawa's teachings, although Nishikawa is not identified as part of the asserted ground of unpatentability. PO Resp. 55–57.

Petitioner's Reply

Petitioner incorporates its contentions as set forth regarding the proposed combination of Aizawa and Inokawa, and responds that Dr. Kenny's consideration of Nishikawa was proper, as providing further support for the proposed combination. Pet. Reply 22–23, 26–27.

Patent Owner's Sur-reply

Patent Owner's Sur-reply generally reiterates its arguments challenging Petitioner's contentions. PO Sur-reply 20–24.

Analysis

As an initial matter, we find that a preponderance of the evidence establishes that the Mendelson-1988 sensor's optically clear epoxy is a light permeable cover that is arranged above a portion of the housing and covers the sensor's detectors. In particular, it is clear from Figures 2A and 2B that the epoxy extends from the top of the sensor at the dotted line in the figure, down into the well of the AIRPAX package, to cover all four LEDs and all six photodiodes disposed at the bottom of the well. *See also* Ex. 1015, 168 ("The optical components were encapsulated inside the package using optically clear adhesive").

We also conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the top surface of Mendelson-1988's cover to include a lens including a single convex protruding surface, in order to increase the amount of backscattered light that will be received by Mendelson-1988's peripheral detectors. Our reasoning is substantially identical to the analysis provided above in connection with the ground based on Aizawa and Inokawa, with Mendelson-1988 replacing Aizawa in the combination. *See supra* Section II.D.3. Patent Owner does not cite, and we do not discern, any material difference between Mendelson-1988 and Aizawa that might lead to a different result here. For the reasons discussed in Section II.D.3, we do not agree with Patent Owner's arguments that the proposed combination

would result in a diminished sensor signal, or that Petitioner improperly relied upon Nishikawa.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

3. Independent Claim 9

Independent claim 9 consists of limitations that are substantially similar to limitations [a]–[d] of claim 1. *Compare* Ex. 1001, 44:37–54, *with id.* at 45:13–23 (reciting "a housing" as opposed to "a circular housing including a planar surface"; "at least four detectors" as opposed to "at least four detectors arranged on the planar surface" and "the four detectors are arranged in a grid pattern"; "a lens" as opposed to "a lens forming a cover" and omitting details of the lens' location; the sensor is "worn by the user" as compared to omitting details regarding user wear).

<u>Petitioner's Contentions</u>

With respect to the "circular housing having a planar surface" requirement, Petitioner points to Mendelson's Figures 2(A) and 2(B) and contends that "Mendelson-1988 discloses that its LEDs and photodiode chips (i.e., emitters and detectors) are mounted on a ceramic substrate (***planar surface***) and housed within an AIRPAX microelectronic package (***housing***)." Pet. 64. Petitioner, however, characterizes the housing shown in those figures, specifically Figure 2(A) as "appear[ing] to have a square shape, not a circular one." *Id.* Petitioner reasons that "[a person of ordinary skill in the art] would have recognized that microelectronic packaging as

used in Mendelson-1988 comes in various shapes and sizes" and "[a person of ordinary skill in the art] would have considered using a differently shaped housing, namely a circular one, to be obvious." *Id.* at 64–65 (citing Ex. 1003 ¶ 162). Petitioner also contends that employing a circular housing was "common practice" prior to the '266 patent, and that "there was nothing new or inventive about changing one housing shape for another." *Id.* at 65 (citing Ex. 1003 ¶ 162). Petitioner explains that its contentions are evidenced by another reference of record, Mendelson '799. *Id.*

<u>Patent Owner's Arguments</u>

Patent Owner characterizes Petitioner's proposed ground for claim 9 as "facially deficient" for several reasons: (1) "[t]he Petition never identifies a motivation to pick a circular-shaped housing instead of the existing square shape"; (2) "[a person of ordinary skill in the art] would have no particular motivation to change the shape unless a [person of ordinary skill in the art] perceived some benefit in doing so"; (3) "Mendelson '799 does not disclose a cover (or even epoxy encapsulation) and thus cannot disclose a circular housing and a cover of the circular housing, as claim 9 requires"; and (4) "Petitioner did not include Mendelson '799 in any ground." PO Resp. 53–55 (citing Ex. 2004 ¶¶ 118–119).

<u>Petitioner's Reply</u>

In response to Patent Owner's arguments, Petitioner replies that "references like Mendelson [']799 have a circular housing and confirm the notion that a [person of ordinary skill in the art] would have found it to be simply a matter of design choice to use different shapes." Pet. Reply 25–26 (citing Ex. 1003 ¶¶ 160–162; Ex. 1025, Fig. 7, 9:34–36; Ex. 1047 ¶ 53).

Petitioner also contends "neither the '266 patent nor [Patent Owner] provides any explanation of how the particular housing shape solves some problem or presents some unexpected result." *Id.* at 26 (citing *In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975)).

Patent Owner's Sur-reply

Patent Owner responds that "Petitioner's reply reiterates its conclusory arguments that [the proposed] change would be routine, without identifying any reason to modify the shape from square to circular." Sur-reply 23.

Analysis

As noted above, we find that a preponderance of the evidence establishes that the Mendelson-1988 sensor's optically clear epoxy is a light permeable cover that is arranged above a portion of the housing and covers the sensor's detectors.[10] In particular, it is clear from Figures 2A and 2B that the epoxy extends from the top of the sensor at the dotted line in the figure, down into the well of the AIRPAX package, to cover all four LEDs and all six photodiodes disposed at the bottom of the well. *See also* Ex. 1015, 168 ("The optical components were encapsulated inside the package using optically clear adhesive.").

We also conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the top surface of Mendelson-1988's epoxy to include a lens including a single convex surface, in order to increase the amount of backscattered light that will be received by Mendelson-1988's peripheral detectors. Our reasoning

[10] We note that claim 1 does not recite a "cover." *See supra* § II.A.1.

is substantially identical to the analysis provided above in connection with the ground based on Aizawa and Inokawa, with Mendelson-1988 replacing Aizawa in the combination. *See supra* Section II.D.3. Patent Owner does not cite, and we do not discern, any material difference between Mendelson-1988 and Aizawa that might lead to a different result here. For the reasons discussed in Section II.D.3, we do not agree with Patent Owner's arguments that the proposed combination would result in a diminished sensor signal, or that Petitioner improperly relied upon Nishikawa.

Further, we determine that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the shape of Mendelson-1988's AIRPAX package from square to circular. Petitioner's and Dr. Kenny's general assessment that a person of ordinary skill in the art would have been aware that a circular housing shape was a known option for housing of components of a physiological sensor finds support in the record. Pet. 64–65; Ex. 1003 ¶¶ 161–162. In that respect, although Mendelson '799 was not listed in the styling of the proposed grounds of unpatentability based on Mendelson-1988 and Inokawa, its teachings plainly were offered in the Petition as evidence of the background knowledge that an ordinarily skilled artisan would have brought to bear in an evaluation of the teachings Mendelson-1988 and Inokawa. Pet. 64–65. Moreover, it is clear that Patent Owner understood that the proposed ground offered in the Petition took into account the disclosure of Mendelson '799, and Patent Owner had opportunity to address that disclosure. Indeed, Patent Owner availed itself of that opportunity during trial (*see, e.g.*, PO Resp. 53–55; Sur-reply 23–24).

We further find unavailing Patent Owner's argument that "Mendelson '799 does not disclose a cover (or even epoxy encapsulation) and thus cannot disclose a circular housing and a cover of the circular housing, as

claim 9 requires." PO Resp. 55. Figure 7 of Mendelson '799 is reproduced below:

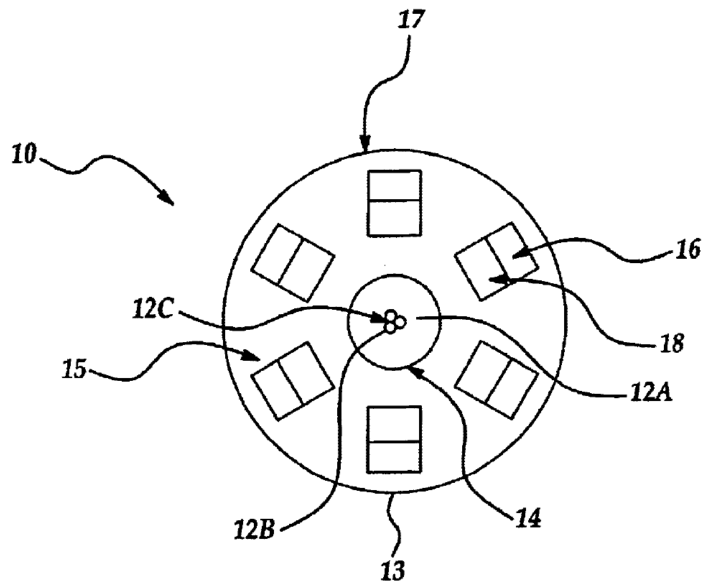


Figure 7

Figure 7 is a top view of optical sensor 10 comprising light source 12 composed of three LEDs 12A, 12B, and 12C emitting light of three different wavelengths, and an array of six near detectors 18 and six far detectors 16 "arranged in two concentric ring-like arrangements" surrounding light source 12. Ex. 1025, 9:23–34. "All these elements are accommodated in a sensor housing 17" which, as can be seen in Figure 7, is clearly circular. *Id.* at 9:34–35. Patent Owner does not articulate why the presence or absence of a cover in Mendelson '799 somehow serves to discount Mendelson '799's unambiguous presentation of a sensor housing having a shape recognizable as circular.

Furthermore, one of ordinary skill in the art would have understood that the AIRPAX package of Mendelson-1988 and the housing 17 of Mendelson '799 are performing the same function of enclosing a central collection of light emitters which are surrounded by an array of light

detectors in an optical sensor attached to a user's body. *See, e.g.*, Ex. 1015, Figs. 2A–2B; Ex. 1025, Fig. 7. The evidence of record also does not suggest that the shape of such a housing has any functional significance in the operation of the optical sensor, or that any particular known shape was preferred or restricted. Thus, the evidence suggests that a square shape and a circular shape of such as housing were known in the art to be predictable substitutes for one another, and therefore obvious variants. *See, e.g.*, *KSR*, 550 U.S. at 416 ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."); *id.* at 417 ("[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." (citation omitted)).

We conclude Petitioner has demonstrated by a preponderance of the evidence that Petitioner's ground based on Mendelson-1988 and Inokawa conveys the unpatentability of claim 9.

4. Dependent Claims 2–6, 8, 10–16, 18, and 19

Petitioner presents undisputed contentions that claims 2–6, 8, 10–16, 18, and 19, which depend directly or indirectly from independent claim 1 or 9, are unpatentable over the combined teachings of Mendelson-1988 and Inokawa, and provides arguments explaining how the references teach the limitations of these claims. Pet. 56–63, 67–71; Ex. 1003 ¶¶ 144–157, 166–175.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1.

PO Resp. 57 ("The Petition fails to establish that independent claims 1 and 9 are obvious . . . and therefore fails to establish obviousness of any of the challenged dependent claims.").

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–6, 8, 10–16, 18, and 19 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

F. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Ohsaki

Petitioner contends that claims 1–6, 8–16, 18, and 19 of the '266 patent would have been obvious over the combined teachings of Aizawa, Inokawa, and Ohsaki. Pet. 44–46.

Because we have already determined that these claims are unpatentable based on Aizawa and Inokawa, and Mendelson-1988 and Inokawa, which is dispositive as to all challenged claims, we need not reach this additional ground. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) ("[T]he Board need not address issues that are not necessary to the resolution of the proceeding."); *see supra* §§ II.D–E.

III. CONCLUSION

In summary:[11]

Claims	**35 U.S.C. §**	**Reference(s)/ Basis**	**Claims Shown Unpatentable**	**Claims Not Shown Unpatentable**
1–6, 8–16, 18, 19	103	Aizawa, Inokawa	1–6, 8–16, 18, 19	
1–6, 8–16, 18, 19	103	Mendelson-1988, Inokawa	1–6, 8–16, 18, 19	
1–6, 8–16, 18, 19	103[12]	Aizawa, Inokawa, Ohsaki		
Overall Outcome			1–6, 8–16, 18, 19	

[11] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

[12] As explained above, because we conclude that the challenged claims are unpatentable on other grounds, we do not reach the merits of this ground.

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–6, 8–16, 18, and 19 of the ’266 patent have been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

FOR PETITIONER:

Walter Renner
Andrew B. Patrick
Hyun Jin In
Dan Smith
FISH & RICHARDSON P.C.
Axf-ptab@fr.com
patrick@fr.com
in@fr.com
PTABInbound@fr.com

FOR PATENT OWNER:

Joseph R. Re
Stephen W. Larson
Jarom D. Kesler
Jacob L. Peterson
KNOBBE, MARTENS, OLSON, & BEAR, LLP
2jrr@knobbe.com
2swl@knobbe.com
2jzk@knobbe.com
2jup@knobbe.com

Trials@uspto.gov
571-272-7822

Paper 32
Date: May 25, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

MASIMO CORPORATION,
Patent Owner.

IPR2021-00209
Patent 10,376,191 B1

Before JOSIAH C. COCKS, ROBERT L. KINDER, and AMANDA F. WIEKER, *Administrative Patent Judges*.

WIEKER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Apple Inc. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 1–6, 8–16, 18, and 19 ("challenged claims") of U.S. Patent No. 10,376,191 B1 (Ex. 1001, "the '191 patent"). Paper 2 ("Pet."). Masimo Corporation ("Patent Owner") waived filing a preliminary response. Paper 6. We instituted an *inter partes* review of all challenged claims 1–6, 8–16, 18, and 19 on all grounds of unpatentability, pursuant to 35 U.S.C. § 314. Paper 7 ("Inst. Dec.").

After institution, Patent Owner filed a Response (Paper 15, "PO Resp.") to the Petition, Petitioner filed a Reply (Paper 18, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 22, "PO Sur-reply"). An oral hearing was held on March 15, 2022, and a transcript of the hearing is included in the record. Paper 31 ("Tr.").

We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, Petitioner has met its burden of showing, by a preponderance of the evidence, that challenged claims 1–6, 8–16, 18, and 19 of the '191 patent are unpatentable.

B. Related Matters

The parties identify the following matters related to the '191 patent:

Masimo Corporation v. Apple Inc., Civil Action No. 8:20-cv-00048 (C.D. Cal.) (filed Jan. 9, 2020);

Apple Inc. v. Masimo Corporation, IPR2020-01520 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,258,265 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01521 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,292,628 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01523 (PTAB Sept. 9, 2020) (challenging claims of U.S. Patent No. 8,457,703 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01524 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,433,776 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01526 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 6,771,994 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01536 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01537 (PTAB Aug. 31, 2020) (challenging claims of U.S. Patent No. 10,588,553 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01538 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01539 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,588,554 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01713 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,624,564 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01714 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01715 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,631,765 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01716 (PTAB Sept. 2, 2020) (challenging claims of U.S. Patent No. 10,702,194 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01722 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01723 (PTAB Oct. 2, 2020) (challenging claims of U.S. Patent No. 10,470,695 B2);

Apple Inc. v. Masimo Corporation, IPR2020-01733 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,702,195 B1);

Apple Inc. v. Masimo Corporation, IPR2020-01737 (PTAB Sept. 30, 2020) (challenging claims of U.S. Patent No. 10,709,366 B1);

Apple Inc. v. Masimo Corporation, IPR2021-00193 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,299,708 B1);

Apple Inc. v. Masimo Corporation, IPR2021-00195 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,376,190 B1); and

Apple Inc. v. Masimo Corporation, IPR2021-00208 (PTAB Nov. 20, 2020) (challenging claims of U.S. Patent No. 10,258,266 B1).

Pet. 71–72; Paper 3, 3–4.

Patent Owner further identifies the following pending patent applications, among other issued and abandoned applications, that claim priority to, or share a priority claim with, the '191 patent:

U.S. Patent Application No. 16/834,538;

U.S. Patent Application No. 17/031,407;

U.S. Patent Application No. 17/031,316;

U.S. Patent Application No. 17/031,356;

U.S. Patent Application No. 16/449,143; and

U.S. Patent Application No. 16/805,605.

Paper 3, 1–3.

C. The '191 Patent

The '191 patent is titled "Multi-Stream Data Collection System for Noninvasive Measurement of Blood Constituents," and issued on August 13,

2019, from U.S. Patent Application No. 16/409,515, filed May 10, 2019. Ex. 1001, codes (21), (22), (45), (54). The '191 patent claims priority through a series of continuation and continuation-in-part applications to Provisional Application Nos. 61/078,228 and 61/078,207, both filed July 3, 2008. *Id.* at codes (60), (63).

The '191 patent discloses a two-part data collection system including a noninvasive sensor that communicates with a patient monitor. *Id.* at 2:35–37. The sensor includes a sensor housing, an optical source, and several photodetectors, and is used to measure a blood constituent or analyte, e.g., oxygen or glucose. *Id.* at 2:26–32, 61–62. The patient monitor includes a display and a network interface for communicating with a handheld computing device. *Id.* at 2:42–45.

Figure 1 of the '191 patent is reproduced below.

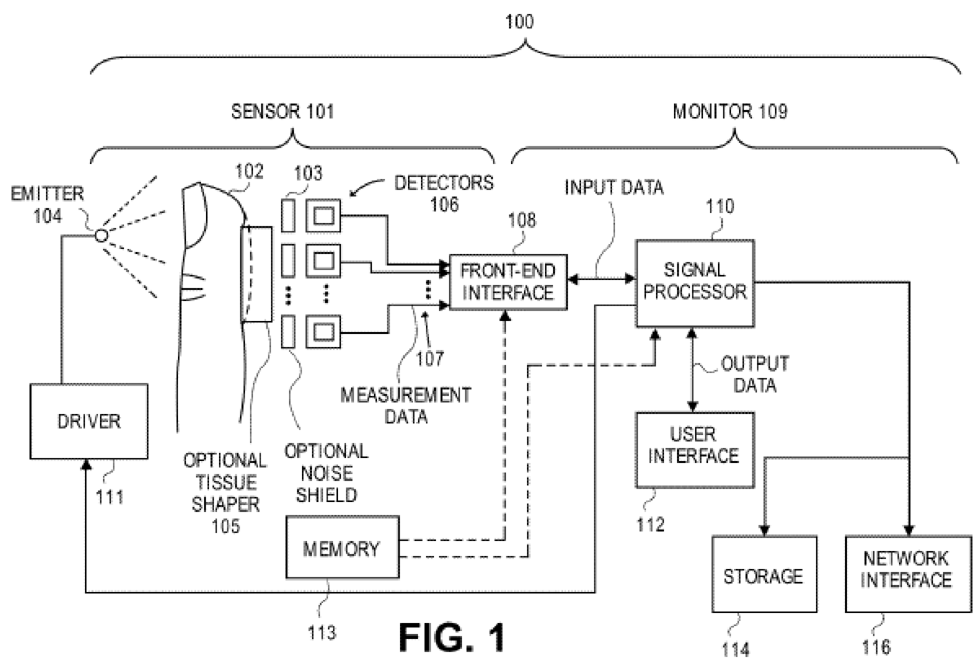


FIG. 1

Figure 1 illustrates a block diagram of data collection system 100 including sensor 101 and monitor 109. *Id.* at 11:42–44. Sensor 101 includes optical emitter 104 and detectors 106. *Id.* at 11:54–56. Emitters 104 emit light that

is attenuated or reflected by the patient's tissue at measurement site 102. *Id.* at 13:67–14:3. Detectors 106 capture and measure the light attenuated or reflected from the tissue. *Id.* In response to the measured light, detectors 106 output detector signals 107 to monitor 109 through front-end interface 108. *Id.* at 14:3–6, 14:22–28. Sensor 101 also may include tissue shaper 105, which may be in the form of a convex surface that: (1) reduces the thickness of the patient's measurement site; and (2) provides more surface area from which light can be detected. *Id.* at 10:57–11:9.

Monitor 109 includes signal processor 110 and user interface 112. *Id.* at 15:12–14. "[S]ignal processor 110 includes processing logic that determines measurements for desired analytes . . . based on the signals received from the detectors." *Id.* at 15:17–20. User interface 112 presents the measurements to a user on a display, e.g., a touch-screen display. *Id.* at 15:42–55. The monitor may be connected to storage device 114 and network interface 116. *Id.* at 15:56–62.

The '191 patent describes various examples of sensor devices. Figures 14D and 14F, reproduced below, illustrate detector portions of sensor devices.

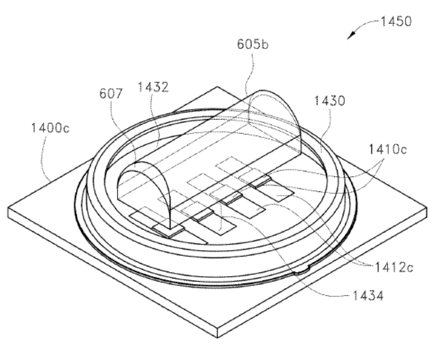


FIG. 14D

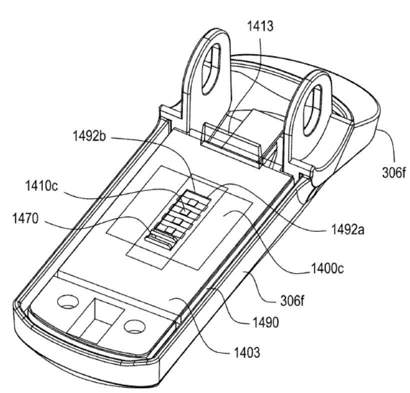


FIG. 14F

Figure 14D illustrates portions of a detector submount and Figure 14F illustrates portions of a detector shell. *Id.* at 6:40–43. As shown in

Figure 14D, multiple detectors 1410c are located within housing 1430 and under transparent cover 1432, on which protrusion 605b (or partially cylindrical protrusion 605) is disposed. *Id.* at 35:36–40, 36:30–37. Figure 14F illustrates a detector shell 306f including detectors 1410c on substrate 1400c. *Id.* at 37:9–17. Substrate 1400c is enclosed by shielding enclosure 1490 and noise shield 1403, which include window 1492a and window 1492b, respectively, placed above detectors 1410c. *Id.* at 37:18–25. Alternatively, cylindrical housing 1430 may be disposed under noise shield 1403 and may enclose detectors 1410c. *Id.* at 37:47–49.

Figures 4A and 4B, reproduced below, illustrate an alternative example of a tissue contact area of a sensor device.

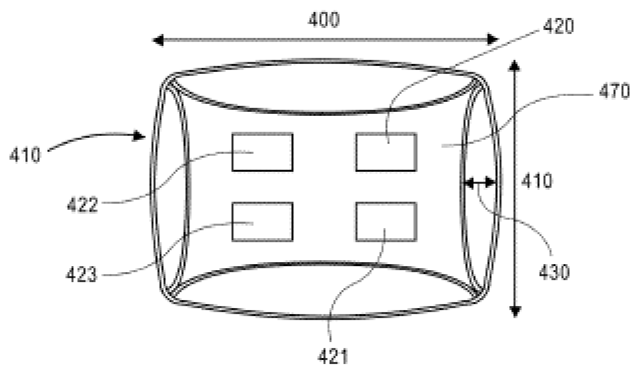


FIG. 4A

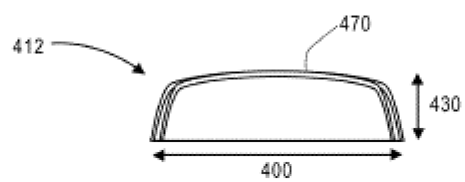


FIG. 4B

Figures 4A and 4B illustrate arrangements of protrusion 405 including measurement contact area 470. *Id.* at 23:13–19. "[M]easurement site contact area 470 can include a surface that molds body tissue of a measurement site." *Id.* "For example, . . . measurement site contact area 470 can be generally curved and/or convex with respect to the measurement site." *Id.* at 23:36–38. The measurement site contact area may include windows 420–423 that "mimic or approximately mimic a configuration of, or even house, a plurality of detectors." *Id.* at 23:44–58.

D. Illustrative Claim

Of the challenged claims, claims 1 and 9 are independent. Claim 1 is illustrative and is reproduced below.

1. A noninvasive optical physiological sensor comprising:

[a] a plurality of emitters configured to emit light into tissue of a user;

[b] a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprise at least four detectors;

[c] a housing configured to house at least the plurality of detectors in a circular portion of the housing; and

[d] a lens configured to be located between tissue of the user and the plurality of detectors when the noninvasive optical physiological sensor is worn by the user, wherein the lens comprises a single outwardly protruding convex surface configured to cause tissue of the user to conform to at least a portion of the single outwardly protruding convex surface when the noninvasive optical physiological sensor is worn by the user and during operation of the noninvasive optical physiological sensor.

Ex. 1001, 44:50–67 (bracketed identifiers [a]–[d] added). Independent claim 9 includes limitations similar to limitations [a]–[d] of claim 1. *Id.* at 45:26–36 (reciting a "planar surface"; "at least four detectors" arranged in a "grid pattern" on the planar surface; and "a lens forming a cover of the housing").

E. Applied References

Petitioner relies upon the following references:

Ohsaki et al., U.S. Patent Application Publication No. 2001/0056243 A1, filed May 11, 2001, published December 27, 2001 (Ex. 1014, "Ohsaki");

Aizawa, U.S. Patent Application Publication No. 2002/0188210 A1, filed May 23, 2002, published December 12, 2002 (Ex. 1006, "Aizawa");

Inokawa et al., Japanese Patent Application Publication No. 2006-296564 A, filed April 18, 2005, published November 2, 2006 (Ex. 1007, "Inokawa");[1] and

Y. Mendelson et al., "Design and Evaluation of a New Reflectance Pulse Oximeter Sensor," Association for the Advancement of Medical Instrumentation, Vol. 22, No. 4, 167–173 (1988) (Ex. 1015, "Mendelson-1988").

Pet. 3. Petitioner also submits, *inter alia*, the Declaration of Thomas W. Kenny, Ph.D. (Ex. 1003), and the Second Declaration of Thomas W. Kenny (Ex. 1047). Patent Owner submits, *inter alia*, the Declaration of Vijay K. Madisetti, Ph.D. (Ex. 2004). The parties also provide deposition testimony from Dr. Kenny and Dr. Madisetti, including from this and other proceedings. *See* Exs. 1034–1036, 2006–2009, 2020, 2027.

F. Asserted Grounds

Petitioner asserts that claims 1–6, 8–16, 18, and 19 are unpatentable based upon the following grounds:

Claim(s) Challenged	35 U.S.C. §	References/Basis
1–6, 8–16, 18, 19	103	Aizawa, Inokawa
1–6, 8–16, 18, 19	103	Aizawa, Inokawa, Ohsaki
1–6, 8–16, 18, 19	103	Mendelson-1988, Inokawa

[1] Petitioner relies on a certified English translation of Inokawa (Ex. 1008). In this Decision, we also refer to the translation.

II. DISCUSSION

A. Claim Construction

For petitions filed on or after November 13, 2018, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2019).

Although both parties contend that no claim term requires express construction (Pet. 3–4; PO Resp. 9), the substance of the parties' briefing demonstrates that there is a dispute regarding the claim term "cover."

1. "cover"

Independent claim 9 requires "a lens forming a cover of the housing." Ex. 1001, 45:27–46:3. Although independent claim 1 also recites "a lens," it does not recite a "cover." *Id.* at 44:50–67.

Patent Owner argues that the claimed "cover" excludes "an optically clear adhesive/epoxy" and a "resin on a surface." PO Resp. 51. According to Patent Owner, "the '191 Patent distinguishes a resin on a surface from a cover, explaining: 'the cylindrical housing 1430 (and transparent cover 1432) . . . can protect the detectors 1410c and conductors 1412c ***more effectively*** than currently-available ***resin epoxies***.'" *Id.* (quoting Ex. 1001, 36:37–46).

Patent Owner alleges that Dr. Kenny also "distinguished a sealing resin from a cover, acknowledging a 'layer of sealing resin' is 'one way to protect the components ***without using a cover***.'" *Id.* at 51–52 (quoting Ex. 2009, 395:22–396:17). Patent Owner argues its understanding is

consistent with the prior art cited by Petitioner. *Id.* at 52 (citing Ex. 1008 ¶ 103, Fig. 17; Ex. 1023 ¶ 35; Ex. 2004 ¶ 113).

Petitioner replies that "there is nothing in the specification or the prosecution history [of the '191 patent] that would lead a [person of ordinary skill in the art] to conclude that 'cover' should be interpreted based on anything other than its plain meaning." Pet. Reply 24 (citing *Thorner v. Sony Computer Entertainment America LLC*, 669 F.3d 1362, 1368 (Fed. Cir. 2012)). That plain meaning, according to Petitioner, is that "a cover is merely 'something that protects, shelters, or guards.'" *Id.* (quoting Ex. 1050; Ex. 1047 ¶ 48). Petitioner argues that Patent Owner's reliance on the '191 patent Specification takes text out of context and, when context is considered, it is clear that "the epoxy resin to which the '191 patent compares its cover is not [an] epoxy cover . . . but rather epoxy that is applied to solder joints." *Id.* at 24–25 (citing Ex. 1001, 36:50–59; Ex. 1047 ¶ 50).

Petitioner also contends that Patent Owner "mischaracterizes Dr. Kenny's deposition testimony to say he agreed that 'sealing resin' is somehow distinguished from a cover." *Id*. at 24. Petitioner contends that Dr. Kenny simply "clarified that using a sealing resin is 'a pretty common way to protect electronic components.'" *Id.* (citing Ex. 2009, 395:22–396:8; Ex. 1047 ¶ 49). Moreover, Petitioner contends that "such extrinsic evidence would not justify departure from plain meaning under *Thorner*." *Id.*

In its Sur-reply, Patent Owner maintains that the '191 patent "specifically ***distinguishes*** a 'resin' on a surface from a 'cover,'" and Petitioner's opposing reading is not persuasive. PO Sur-reply 20–21.

Upon review of the record, we disagree with Patent Owner's limiting construction of "cover" to exclude epoxy and resin. The plain and ordinary meaning of the term does not support Patent Owner's view. A "cover" ordinarily connotes "something that protects, shelters, or guards." Ex. 1050 (*Merriam-Webster's Collegiate Dictionary*, 11th ed. (©2005)), 288. That plain and ordinary meaning is consistent with the '191 patent's description of "flex circuit cover 360, which can be made of plastic or another suitable material . . . [and] can cover and thereby protect a flex circuit (not shown)." Ex. 1001, 22:66–23:2. It is also consistent with the '191 patent's description and illustration of "transparent cover 1432" in Figure 14D, which covers and protects detectors 1410c and conductors 1412c, and which "can be fabricated from glass or plastic, *among other materials*." *See id.* at 36:42–49 (emphasis added), Figs. 14D–14E.

This is not the situation in which a special definition for a claim term has been set forth in the specification with reasonable clarity, deliberateness, and precision, so as to give notice of the inventor's own lexicography. *See Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370 (Fed. Cir. 2005); *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Nor do we discern that Patent Owner "demonstrate[d] an intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope." *Teleflex, Inc. v. Ficosa North America Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002).

Here, based upon our review of the intrinsic evidence, no such special definition or express disavowal of the term "cover" to exclude epoxy and

resin exists. Patent Owner relies on the following description of Figure 14D in that regard:

> *In certain embodiments, the cylindrical housing 1430 (and transparent cover 1432)* forms an airtight or substantially airtight or hermetic seal with the submount 1400c. As a result, the cylindrical housing 1430 can protect the detectors 1410c and conductors 1412c from fluids and vapors that can cause corrosion. Advantageously, *in certain embodiments, the cylindrical housing 1430 can protect* the detectors 1410c and conductors 1412c *more effectively than currently-available resin epoxies*, which are sometimes applied to solder joints between conductors and detectors.

Ex. 1001, 36:50–59 (emphases added). First, the sentence cited by Patent Owner begins with the phrase "[i]n certain embodiments," which indicates the claimed invention is not limited and is open to other embodiments, so there is no lexicography or disavowal here. Second, we agree with Petitioner's reading of this passage as distinguishing the prior art from the claimed invention based on the *location* of the material (applied only to solder joints between conductors and detectors in the prior art, as opposed to covering the conductors and detectors in the invention) and not the *type* of material. Third, at best, the '191 patent expresses a preference for a cover to be made of glass or plastic, because such materials provide "more effective[]" protection than resin epoxies that were known when the '191 patent was filed. *See id.* at 36:55–59. But even this reading recognizes that resin epoxies provide some amount of protection, albeit perhaps a lesser amount than glass or plastic, and are not excluded from forming the material of a cover.

Dr. Kenny's deposition testimony cited by Patent Owner also does not persuade us that, in the context of the '191 patent, epoxy or resin is excluded from the material of a cover. Dr. Kenny testifies that "a layer of sealing

resin" "[c]ould" be used to protect the electronic components in a sensor (Ex. 2009, 395:22–396:8). He was then asked "So that would be one way to protect the components without using a cover, correct?" to which he answered "[t]here are many ways to protect the elements other than using a cover" and maintained that the proposed combination of prior art has a "cover" to achieve purposes *other than* protecting electronic components, i.e., "to improve adhesion and to improve light gathering for the operation of the system." *Id.* at 396:9–17. He did not squarely testify that sealing resin may never be a cover.

Accordingly, in the context of the '191 patent, we do not construe the claimed "cover" to exclude epoxy and resin.

2. Other Claim Terms

Upon consideration of the entirety of the arguments and evidence presented, we conclude no further explicit construction of any claim term is needed to resolve the issues presented by the arguments and evidence of record. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (per curiam) (claim terms need to be construed "only to the extent necessary to resolve the controversy" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said

subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of non-obviousness.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner identifies the appropriate level of skill in the art as that possessed by a person having "a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of

[2] Patent Owner does not present objective evidence of non-obviousness.

related work experience with capture and processing of data or information." Pet. 4 (citing Ex. 1003 ¶¶ 21–22). "Alternatively, the person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline." *Id.*

Patent Owner makes several observations regarding Petitioner's identified level of skill in the art but, "[f]or this proceeding, [Patent Owner] nonetheless applies Petitioner's asserted level of skill." PO Resp. 10 (citing Ex. 2004 ¶¶ 35–38).

We adopt Petitioner's assessment as set forth above, which appears consistent with the level of skill reflected in the Specification and prior art.

D. Obviousness over the Combined Teachings of Aizawa and Inokawa

Petitioner contends that claims 1–6, 8–16, 18, and 19 of the '191 patent would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 6–43.

1. Overview of Aizawa (Ex. 1006)

Aizawa is a U.S. patent application publication titled "Pulse Wave Sensor and Pulse Rate Detector," and discloses a pulse wave sensor that detects light output from a light emitting diode and reflected from a patient's artery. Ex. 1006, codes (54), (57).

Figure 1(a) of Aizawa is reproduced below.

FIG. 1 (a)

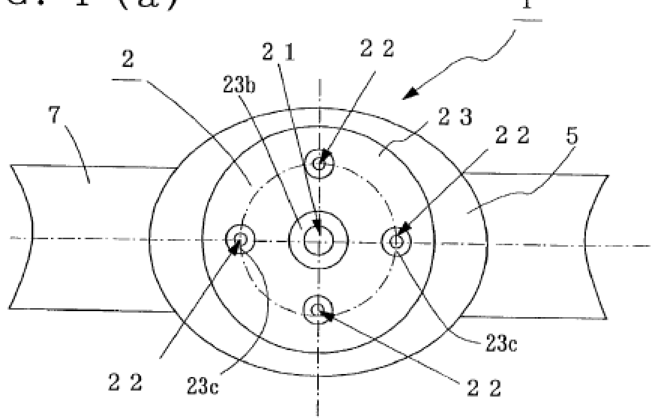


Figure 1(a) is a plan view of a pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(a), pulse wave sensor 2 includes light emitting diode ("LED") 21, four photodetectors 22 symmetrically disposed around LED 21, and holder 23 for storing LED 21 and photodetectors 22. *Id.* Aizawa discloses that, "to further improve detection efficiency, . . . the number of the photodetectors 22 may be increased." *Id.* ¶ 32, Fig. 4(a). "The same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector 22." *Id.* ¶ 33.

Figure 1(b) of Aizawa is reproduced below.

FIG. 1 (b)

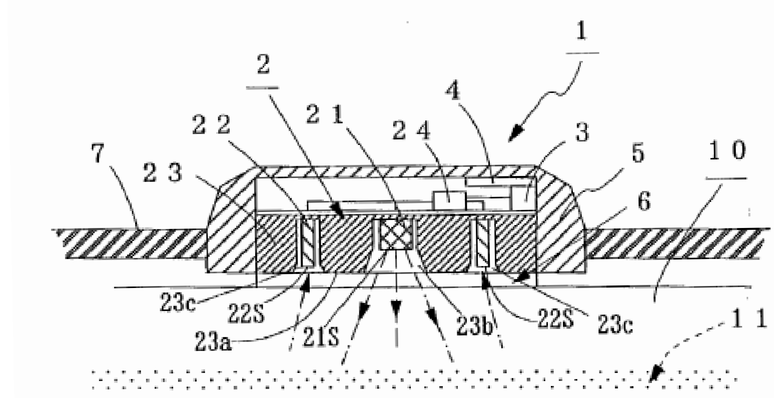


Figure 1(b) is a sectional view of the pulse wave sensor. *Id.* ¶ 23. As shown in Figure 1(b), pulse wave sensor 2 includes drive detection circuit 24 for detecting a pulse wave by amplifying the outputs of photodetectors 22. *Id.* ¶ 23. Arithmetic circuit 3 computes a pulse rate from the detected pulse wave and transmitter 4 transmits the pulse rate data to an "unshown display." *Id.* The pulse rate detector further includes outer casing 5 for storing pulse wave sensor 2, acrylic transparent plate 6 mounted to detection face 23a of holder 23, and attachment belt 7. *Id.* ¶ 23.

Aizawa discloses that LED 21 and photodetectors 22 "are stored in cavities 23b and 23c formed in the detection face 23a" of the pulse wave sensor. *Id.* ¶ 24. Detection face 23a "is a contact side between the holder 23 and a wrist 10, respectively, at positions where the light emitting face 21s of the light emitting diode 21 and the light receiving faces 22s of the photodetectors 22 are set back from the above detection face 23a." *Id.* ¶ 24. Aizawa discloses that "a subject carries the above pulse rate detector 1 on the inner side of his/her wrist 10 . . . in such a manner that the light emitting face 21s of the light emitting diode 21 faces down (on the wrist 10 side)." *Id.* ¶ 26. Furthermore, "the above belt 7 is fastened such that the acrylic transparent plate 6 becomes close to the artery 11 of the wrist 10. Thereby, adhesion between the wrist 10 and the pulse rate detector 1 is improved." *Id.* ¶¶ 26, 34.

2. *Overview of Inokawa (Ex. 1008)*

Inokawa is a Japanese published patent application titled "Optical Vital Sensor, Base Device, Vital Sign Information Gathering System, and Sensor Communication Method," and discloses a pulse sensor device. Ex. 1008 ¶ 6.

Figure 1 of Inokawa is reproduced below.

(FIG. 1)

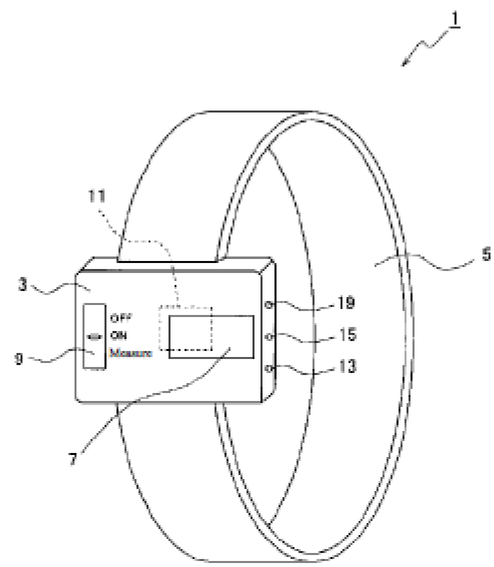


Figure 1 illustrates a schematic view of a pulse sensor. *Id.* ¶ 56. Pulse sensor 1 includes box-shaped sensor unit 3 and flexible annular wristband 5. *Id.* ¶ 57. Sensor unit 3 includes a top surface with display 7 and control switch 9, and a rear surface (sensor-side) with optical device component 11 for optically sensing a user's pulse. *Id.*

Figure 2 of Inokawa is reproduced below.

(FIG. 2)

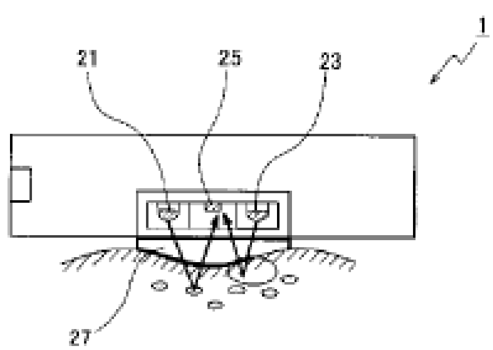


Figure 2 illustrates a schematic view of the rear surface of the pulse sensor. *Id.* ¶ 58. The rear-side (sensor-side) of pulse sensor 1 includes a pair of light-emitting elements, i.e., green LED 21 and infrared LED 23, as well as

photodiode 25 and lens 27. *Id.* In various embodiments, Inokawa discloses that the sensor-side lens is convex. *See id.* ¶¶ 99, 107. Green LED 21 senses "the pulse from the light reflected off of the body (i.e.[,] change in the amount of hemoglobin in the capillary artery)," and infrared LED 23 senses body motion from the change in reflected light. *Id.* ¶ 59. The pulse sensor stores this information in memory. *Id.* ¶ 68. To read and store information, the pulse sensor includes a CPU that "performs the processing to sense pulse, body motion, etc. from the signal . . . and temporarily stores the analysis data in the memory." *Id.* ¶ 69.

Figure 3 of Inokawa is reproduced below.

(FIG. 3)

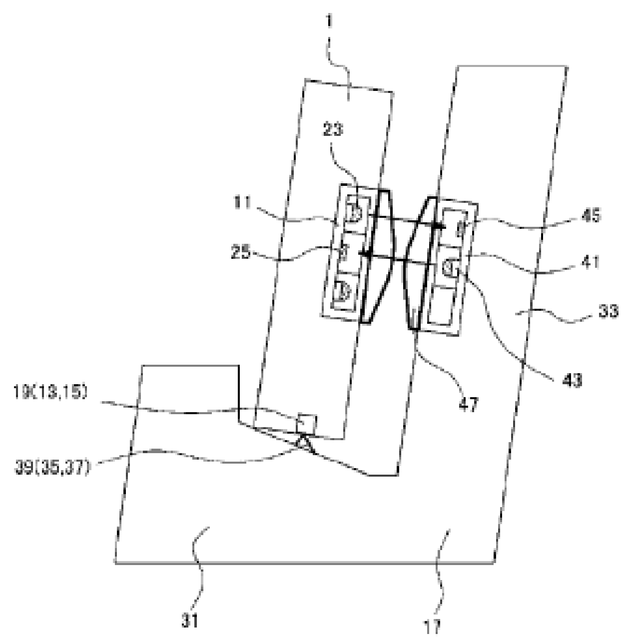


Figure 3 illustrates a schematic view of a pulse sensor mounted to a base device. *Id.* ¶ 60. Pulse sensor 1 is depicted as mounted to base device 17, which "is a charger with communication functionality." *Id.* When so mounted, sensor optical device component 11 and base optical device component 41 face each other in close proximity. *Id.* ¶ 66. In this position,

pulse sensor 1 can output information to the base device through the coupled optical device components. *Id.* ¶ 67. Specifically, the pulse sensor CPU performs the controls necessary to transmit pulse information using infrared LED 23 to photodetector 45 of base device 17. *Id.* ¶¶ 67, 70, 76. In an alternative embodiment, additional sensor LEDs and base photodetectors can be used to efficiently transmit data and improve accuracy. *Id.* ¶ 111.

3. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Aizawa and Inokawa. Pet. 13–22 (combination), 22–29 (claim 1).

i. "A noninvasive optical physiological sensor comprising"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses a noninvasive optical physiological measurement device, i.e., a pulse sensor. Pet. 22–23; *see, e.g.*, Ex. 1006 ¶ 2 ("[A] pulse wave sensor for detecting the pulse wave of a subject from light reflected from a red corpuscle in the artery of a wrist of the subject by irradiating the artery of the wrist with light.").

ii. "[a] a plurality of emitters configured to emit light into tissue of a user"

Petitioner's Undisputed Contentions

Petitioner contends that Aizawa discloses one emitter—LED 21—and also states that, in certain embodiments, multiple LEDs may be employed. Pet. 7, 17. Patent Owner does not dispute this contention, and we agree with Petitioner. *See* Ex. 1006 ¶¶ 23 ("LED 21"), 32 ("The arrangement of the

light emitting diode 21 and the photodetectors 22 is not limited to this.”). For example, Aizawa explains that “[t]he same effect can be obtained when the number of photodetectors 22 is 1 and a plurality of light emitting diodes 21 are disposed around the photodetector.” *Id.* ¶ 33.

Petitioner also contends that Inokawa teaches a sensor with two LEDs, a green LED to sense pulse and an infrared LED to sense body motion. Pet. 10–11. Petitioner contends that when Inokawa’s sensor is mounted on a base device, the infrared LED is used to wirelessly transmit vital information to the base device. *Id.* at 12–13. Patent Owner does not dispute these contentions, and we agree with Petitioner. Inokawa teaches a pair of LEDs 21, 23, where “the basic function of the S-side green LED 21 is to sense the pulse from the light reflected off of the body . . ., while the S-side infrared LED 23 serves to sense body motion from the change in this reflected light.” Ex. 1008 ¶¶ 58–59. Inokawa also explains that “vital sign information stored in the memory 63 [of the sensor], such as pulse and body motion, is transmitted to the base device 17 using the S-side infrared LED 23 of the pulse sensor 1 and the B-side PD 45 of the base device 17,” such that “there is no need to use a special wireless communication circuit or a communication cable.” *Id.* ¶¶ 76–77.

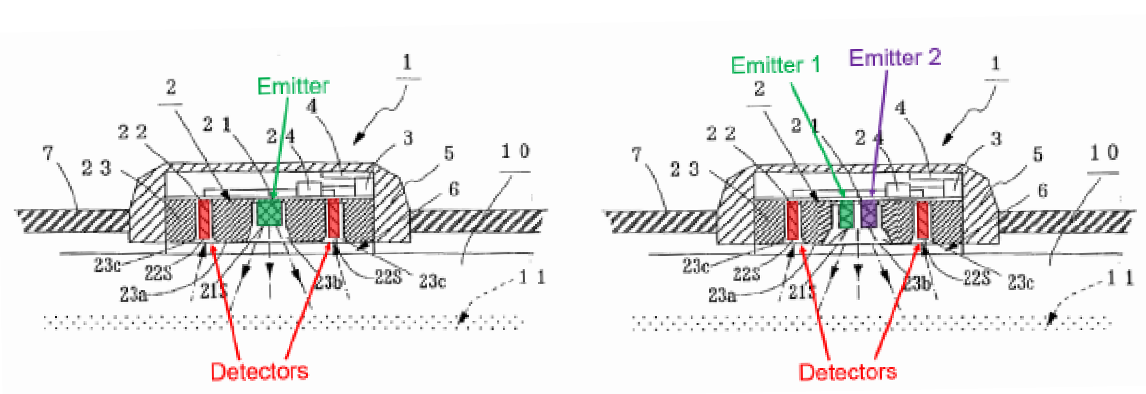
<u>Petitioner’s Disputed Contentions</u>

Moreover, Petitioner contends that a person of ordinary skill in the art would have been motivated to “provid[e] an additional emitter to Aizawa [to] allow Aizawa’s device to use its existing infrared LED to detect body motion while using the added green LED to detect pulse,” which would have provided “more reliable pulse measurement that takes into account and

corrects for inaccurate readings stemming from body movement." Pet. 17–18, 24; Ex. 1003 ¶¶ 71–73.

As a second and independent motivation, Petitioner also contends that incorporating Inokawa's teachings would have allowed for wireless data communication from Aizawa's sensor, without the need for a physical communications cable or a separate wireless communication circuit. Pet. 20–21. Petitioner contends that although Aizawa discloses data transmission, Aizawa "is silent about how such transmission would be implemented." *Id.* at 19–20. According to Petitioner, a skilled artisan "would have . . . recognized that incorporating Inokawa's base device and LED-based data transmission would allow Aizawa to upload data from its sensor in a way that is wireless (thus avoiding the problems of a physical cable) and that does not require a separate RF circuit," and which would "improve data transmission accuracy by using the second LED, such as the green LED, to transmit checksum information." *Id.* at 21–22 (citing, e.g., Ex. 1003 ¶¶ 77–79).

To illustrate its proposed modification, Petitioner includes annotated and modified views of Aizawa's Figure 1(b), reproduced below. Pet. 18; *see also id.* at 23 (same); Ex. 1003 ¶ 72.



Petitioner's modified figure on the left depicts the sensor of Aizawa, with its single emitter identified and colored green; Petitioner's modified figure on the right depicts Aizawa's sensor in which the single emitter has been divided into two emitters, colored green and purple, operating at two different wavelengths, as Petitioner contends would have been rendered obvious by Inokawa. Pet. 18–19, 23–24. Petitioner contends that this modification entails use of a known solution to improve similar systems in the same way and would have achieved predictable results. *Id.* at 19, 22 (citing Ex. 1003 ¶¶ 73–74, 80); *see also id.* at 23–24 (citing, e.g., Ex. 1003 ¶¶ 69–81).

Patent Owner's Arguments

Patent Owner disputes Petitioner's contentions regarding the obviousness of modifying Aizawa to include two emitters. *See* PO Resp. 36–42; Sur-reply 13–15.

First, Patent Owner argues that neither Aizawa nor Inokawa discloses a device with multiple detectors *and* multiple emitters in the *same* sensor, because Aizawa's embodiments have either a single emitter and multiple detectors (e.g., Ex. 1006, Fig. 1(a)) or multiple emitters and a single detector (e.g., *id.* ¶ 33), and Inokawa discloses multiple emitters and a single detector (e.g., Ex. 1008, Fig. 2). *See* PO Resp. 36–37 (citing, e.g., Ex. 2004 ¶¶ 79–80).

Second, Patent Owner argues that the evidence does not support either of Petitioner's two proffered motivations for modifying Aizawa to include two emitters. As to the first motivation (to measure body movement using a second emitter), Patent Owner asserts that Dr. Kenny erroneously testifies that Aizawa cannot do this with its single emitter. PO Resp. 38 (citing, e.g.,

Ex. 1006 ¶ 15; Ex. 2007, 400:7–401:10; Ex. 2004 ¶ 84). Patent Owner argues that "Aizawa, however, expressly states that it provides a 'device for ***computing*** the ***amount*** of motion load from the pulse rate.'" *Id.*

As to Petitioner's second motivation (to enable data transmission to a base device using an optical communication link), Patent Owner argues that "Aizawa ***already*** includes a wireless transmitter . . . so Aizawa does not need to incorporate Inokawa's base-device [optical] data transmission arrangement." PO Resp. 38–39 (citing, e.g., Ex. 1006 ¶¶ 23, 28, 35; Ex. 2004 ¶¶ 85–86). Indeed, Patent Owner argues "Dr. Kenny acknowledged Aizawa does not indicate there are any problems with Aizawa's form of data transmission." *Id.* at 39 (citing Ex. 2007, 409:13–410:2). Patent Owner further argues that "Aizawa's goal is 'real-time measuring' with the transmitter 'transmitting the measured pulse rate data to a display'" but that "Inokawa's base device, however, only transmits pulse rate data 'when the pulse sensor . . . is mounted onto the base device'" and, thus, "***eliminates*** the ability to take and display ***real-time*** measurements." *Id.* at 39–40 (citing, e.g., Ex. 1006 ¶¶ 4, 15; Ex. 1008, Abstract; Ex. 2004 ¶ 86).

Patent Owner insists Inokawa does not aid Petitioner's case because Inokawa discloses the benefits of using a second emitter in only two situations: (1) to improve over a "mechanically-connected system," e.g., with a cable for communication, and, (2) to avoid use of a "dedicated wireless communication circuit," whereas "Aizawa ***already*** uses wireless transmission to provide real-time heart measurements." *Id.* at 40–41 (citing, e.g., Ex. 1008 ¶ 4; Ex. 2004 ¶ 87).

Third, Patent Owner accuses Petitioner and Dr. Kenny of overlooking further complications that would ensue from modifying Aizawa to have two emitters. Patent Owner argues that Dr. Kenny overlooked how placing "two LEDs in close proximity may cause thermal interference that could create significant issues for sensor performance." PO Resp. 41 (citing, e.g., Ex. 2004 ¶ 88). Patent Owner also argues that in the proposed modification, when Dr. Kenny added a second LED, "he widened [Aizawa's] cavity without . . . disclosing in his declaration that he had done so," which could impact optical performance of the device. *Id.* at 41–42.

Petitioner's Reply

Concerning Petitioner's first motivation, Petitioner asserts that Aizawa does not disclose any details related to data transmission, and adding an additional LED enables the sensor to distinguish between blood flow and body movement, which provides a "more reliable" pulse measurement, which is Petitioner's asserted improvement to Aizawa. Pet. Reply 16 (citing, e.g., Ex. 1003 ¶ 72; Ex. 2007, 401:11–402:4; Ex. 1047 ¶ 36). Moreover, Petitioner contends that by using multiple LEDs at different wavelengths, "two separate signals" can be collected, which "will allow Aizawa's system to 'take into account and correct for inaccurate readings related to body movement' by subtracting the 'signal component corresponding to body movement [] from the pulse signal to help better isolate the desired pulse data.'" *Id.* (quoting Ex. 1003 ¶ 72).

Concerning Petitioner's second motivation, Petitioner maintains that Inokawa's use of two emitters having different wavelengths to upload data to a base device using optical communication advantageously improves the accuracy of the transmission by providing checksum information. *Id.* at 17

(citing, e.g., Ex. 1003 ¶ 78; Ex. 1008 ¶¶ 111, 44, 48; Ex. 2007, 407:7–408:20, 416:5–15; Ex. 1047 ¶ 38). Moreover, Petitioner notes that Aizawa mentions real-time measurement only once and does not "mention that such data must also be transmitted to some external device in real time." *Id.* at 18 (citing Ex. 1047 ¶ 38). Likewise, Petitioner explains that a person of ordinary skill in the art "would have been fully capable of weighing potential benefits associated with different transmission methods, for instance recognizing that a quicker transmission may be achieved in one instance and a more accurate one in another." *Id.*

As to the "other complications" that Patent Owner alleges would result from the proposed modification, Petitioner asserts "such minor issues are 'part of what [a person of ordinary skill in the art] would bring . . . to the problem and would know how to make the changes needed.'" *Id.* at 18 (quoting Ex. 2007, 384:8–388:12; Ex. 1047 ¶ 39).

<u>Patent Owner's Sur-reply</u>

Concerning Petitioner's first motivation, Patent Owner argues that Inokawa's disclosure is just as sparse as Aizawa's disclosure regarding how to use optical data to measure body movement. PO Sur-reply 13–14 (citing Ex. 1008 ¶ 59). Patent Owner also asserts that "Petitioner cites nothing in Inokawa that suggests" that Inokawa's two emitter data gathering is more reliable or otherwise superior to Aizawa's single emitter data gathering. *Id.*

Concerning Petitioner's second motivation, Patent Owner argues that the proposed modification eliminates Aizawa's ability to conduct "***real-time*** collection and display of physiological measurements—a key goal of Aizawa's system." *Id.* at 14.

Patent Owner also notes that Petitioner does not dispute that the proposed modification would cause problems such as "additional costs, energy use, and thermal problems" that would ensue from using two emitters in Aizawa's device. *Id.* at 15.

Analysis

Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, in light of Inokawa.

First, a person of ordinary skill in the art would have been motivated to make this replacement to improve the pulse measurements recorded by Aizawa's detector. Inokawa teaches that the infrared LED's signal can be used "to detect vital signs" such as "body motion," and the green LED's signal can be "used to detect pulse." Ex. 1008, Fig. 2, ¶¶ 7, 14, 58–59.

Patent Owner correctly points out that Aizawa describes its single-emitter detector as transmitting its pulse data to "a device for computing the amount of motion load from the pulse rate." Ex. 1006 ¶¶ 15, 28, 35. But, this description is the only cited disclosure in Aizawa concerning computing a motion characteristic of the user. Further, we are unable to discern any other disclosure in Aizawa relating to motion computation, or what Aizawa proposes to do with its motion computation. *See id.* Based on the sparse nature of Aizawa's disclosure concerning motion load, it is not clear exactly what Aizawa proposes to do with the computed motion load, after it is computed. *See, e.g.*, Ex. 1047 ¶ 36 ("Patent Owner fails to explain how Aizawa senses and computes motion load. Indeed, Aizawa is completely silent on this point."). Aizawa does,

however, describe the motion load as being computed "from the pulse rate," rather than being an input to the pulse rate calculation. Ex. 1006 ¶¶ 15, 35.

In a deposition for other proceedings related to this *inter partes* review, *see supra* § I.B, Dr. Kenny whether "Aizawa's sensor could not account for motion load?"; Dr. Kenny answered that "Aizawa's sensor attempts to prevent motion load rather than account for it." Ex. 2007, 400:7–11 (deposition for IPR2020-01520, IPR2020-01537, and IPR2020-01539). He explained that, because Aizawa uses only a single emitter with a single wavelength, "what [Aizawa] sees as a signal would be some mixture of pulse rate and motion load if there was no effort to prevent motion load," so Aizawa seeks to solve the problem of "prevent[ing] motion load from corrupting the pulse rate signal." *Id.* at 400:12–401:10. Dr. Kenny did not further explain this distinction between preventing and accounting for motion load in his deposition testimony cited by the parties as relating to this issue. *Id.* at 400:7–402:4. We do not rely on this distinction as a basis for our present decision, because we find no express support for it in Aizawa's disclosure (*see* Ex. 1006 ¶¶ 15, 28, 35), and it is not explained in persuasive detail by Dr. Kenny.

We nonetheless credit Dr. Kenny's declaration testimony that a person of ordinary skill in the art, upon reviewing Inokawa's disclosure of using two emitters of different wavelengths to calculate a user's pulse and motion separately, would have understood that these two separate measurements would "allow for a more reliable pulse measurement that takes into account *and corrects for* inaccurate readings stemming from body movement" by "subtracting the 'signal component corresponding to body movement [] from the pulse signal to help better isolate the desired pulse data.'" Ex. 1047

¶¶ 35, 36, 37 ("processed in a way to compensate for movement and create a more reliable measurement of the physiological parameter"); Ex. 1003 ¶¶ 71–73. Aizawa does not disclose using the computed motion load in this fashion, so it appears that this would improve upon the accuracy of Aizawa's pulse measurements, by using the computed motion load to isolate and account for noise. *See* Ex. 1006 ¶¶ 15, 28, 35.

Dr. Madisetti offers no meaningful opposing testimony in this regard. *See, e.g.*, Ex. 2004 ¶ 84. Instead, Dr. Madisetti incorrectly reads Dr. Kenny's motivation testimony as being limited to the desirability of adding the bare ability to measure body movement to Aizawa. *See id.* In fact, Dr. Kenny further testified that it would have been beneficial to *use* the measured body movement to *improve* the pulse measurement of the device. *See* Ex. 1003 ¶¶ 71–73; Ex. 1047 ¶¶ 36–37. Dr. Madisetti does not address that testimony. *See* Ex. 2004 ¶ 84.

Thus, because Dr. Madisetti's testimony sets up a straw man to attack, rather than directly addressing the entirety of Dr. Kenny's testimony in this regard, Dr. Kenny's testimony stands unrebutted in the record before us. Dr. Kenny's testimony also makes intuitive sense that measuring the user's motion *separately* from the user's pulse measurement, for example by using two interrogating emitters of two different wavelengths, would provide a reliable means of correcting the pulse data for motion artifacts by using the separately measured motion data, rather than by trying to segregate these two components in the single data stream provided by Aizawa's single emitter device. *See, e.g.*, Ex. 1047 ¶¶ 36–37. We, therefore, are persuaded by Dr. Kenny's unrebutted testimony that using two emitters of different wavelengths would improve Aizawa's device in this way.

Independently, we are also persuaded that a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, to provide a reliable method of uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for display to the user. Inokawa expressly touts such optically-based uploading of data from Inokawa's wrist-worn sensor 1 to Inokawa's base device 17 as a benefit of incorporating two emitters in sensor 1. *See* Ex. 1008, Figs. 3, 19, ¶¶ 3–7, 14, 76–77, 109–111. Inokawa identifies two specific benefits of this optically-based data communication means. First, the infrared LED can transmit the pulse data, and the green LED can separately transmit "checksum" information to increase the accuracy of data transmission. *Id.* at Fig. 19, ¶¶ 14, 109–111. Second, using light emitters in this fashion to perform two functions (data collection by emitting light into the user's wrist, and data transmission by emitting light to photodetectors in a base device) obviates the need for providing "a special wireless communication circuit [in the wrist-worn sensor 1] or a communication cable." *Id.* ¶¶ 3–7, 76–77.

Patent Owner correctly points out that Aizawa already has a "transmitter" 4 for uploading pulse data stored by Aizawa's wrist-worn pulse rate detector 1 to another device for processing and for display to the user. Ex. 1006, Fig. 1(b), ¶¶ 15, 23, 28, 35. However, Aizawa's Figure 1(b) illustrates transmitter 4 only as an empty box contained within outer casing 5, and Aizawa's written description does not provide further structural details concerning transmitter 4. *See id.* In particular, Aizawa does not describe exactly how transmitter 4 transmits its data to the other device. *See id.*

Patent Owner contends that Aizawa's transmitter 4 is a "wireless" transmitter, and Dr. Kenny agreed to as much during his deposition. *See, e.g.*, PO Resp. 40; Ex. 2007, 414:19–21. They appear to equate "wireless" communication to radio frequency communication, and not to include optical communication, even though both radio frequency and optical communication do not use a wire. Based on the foregoing testimony, we assume, for this decision, that Aizawa contemplates radio frequency communication as one embodiment by which transmitter 4 may transmit data to devices other than detector 1.

Patent Owner argues, and Dr. Madisetti testifies, that Aizawa's express disclosure goes even further. They assert Aizawa's "goal" is to measure and display pulse data *in real time during exercise*, using the wireless transmitter. *See, e.g.*, PO Resp. 39; Ex. 2004 ¶¶ 86 ("the ability to take and display real-time measurements, one of Aizawa's stated goals"), 87. We find that Aizawa does not support this assertion. Instead, Aizawa discusses prior art devices that "estimat[e] a burden on the heart of a person who takes exercise by *real-time measuring* his/her heart rate at the time of exercise" (Ex. 1006 ¶ 4 (emphasis added)), and then describes Aizawa's detector 1 as having a transmitter for transmitting the measured pulse rate data to another device for display (*id.* ¶ 15). Aizawa does not indicate when this transmission occurs. Aizawa also refers to "noise caused by the shaking of the body of the subject" as a problem to be addressed (*id.* ¶ 6), but this problem occurs regardless of whether the shaking results from exercise or the normal movement of the user's wrist over the course of the day. Thus, Aizawa does not tout, as an important feature of Aizawa's invention, the *real time display* of pulse rate data during exercise, regardless of whether the

data gathered by Aizawa's wrist-worn detector 1 is transmitted wirelessly or otherwise. *Id.* ¶¶ 4, 6, 15.

No doubt, a person of ordinary skill in the art would have viewed the capability of a wrist-worn pulse detector to transmit its pulse data to another device for display in real time while the user is exercising to be a desirable feature in some cases, even if this is not one of Aizawa's specifically stated goals. *See, e.g.*, Ex. 1048 ¶ 67 (Dr. Kenny stating: "By wirelessly transmitting the collected data . . . the condition of a subject [can be determined] 'remotely.'"); Ex. 2009, 393:6–14 (in a deposition for other related proceedings, Dr. Kenny agreeing that a person of ordinary skill in the art "would have seen the ability to wirelessly transmit collected data as an advantage"). Nonetheless, Inokawa expressly discloses that, in other cases, the benefits achieved by wireless transmission can be outweighed by obviating the need for the wrist-worn sensor to include a special wireless communication circuit. *See* Ex. 1008 ¶¶ 3–7 (discussing problems associated with wireless transmission, such as the need for a dedicated circuit, which is avoided by Inokawa's system with "few malfunctions" and a "simple structure"), 76–77 ("As a result, there is no need to use a special wireless communication circuit . . ., which makes it possible to transmit vital sign information to the base device 17 accurately, easily, and without malfunction."). We therefore conclude that Petitioner's case for obviousness in this regard is supported by a preponderance of the evidence. *See, e.g.*, *In re Urbanski*, 809 F.3d 1237, 1243–44 (Fed. Cir. 2016) (persons of ordinary skill in the art may be motivated to pursue desirable properties of one prior art reference, even at the expense of foregoing a benefit taught by another prior art reference).

We disagree with Patent Owner's argument that Petitioner's case for obviousness is deficient on the basis that neither Aizawa nor Inokawa expressly discloses a wrist-worn sensor device that has *both* a plurality of emitters *and* at least four detectors, as claim 1 recites. Obviousness does not require "'some motivation or suggestion to combine the prior art teachings' [to] be found in the prior art." *KSR*, 550 U.S. at 407, 415–418. Nor does it require the bodily incorporation of Inokawa's device into Aizawa's device. *See, e.g.*, *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (test for obviousness is not whether the features of one reference may be bodily incorporated into the structure of the other reference, but rather is "what the combined teachings of the references would have suggested to those of ordinary skill in the art"); *see also In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (nonobviousness is not established by attacking references individually when unpatentability is predicated upon a combination of prior art disclosures). Instead, "[a] person of ordinary skill is also a person of ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420–421.

In this case, we are persuaded that a person of ordinary skill in the art would have been motivated to modify Aizawa's wrist-worn detector 1 to replace its single near infrared LED 21 with an infrared LED and a green LED, based on Inokawa, for all the reasons provided above. A person of ordinary skill in the art would additionally have known to keep all four detectors 22 that are already present in Aizawa's detector 1, so that "[e]ven when the attachment position of the sensor is dislocated, a pulse wave can be detected accurately," as disclosed by Aizawa. Ex. 1006 ¶¶ 9, 27. In short,

the combination of Aizawa and Inokawa teaches that having multiple emitters is beneficial, and having multiple detectors is beneficial, for different and not inconsistent reasons.

Finally, we agree with Petitioner's position that any thermal interference and power consumption issues that may arise in Aizawa's wrist-worn pulse detector, by using two emitters instead of one emitter, are well within the capabilities of a person of ordinary skill in the art to solve. We credit Dr. Kenny's testimony in this regard. *See* Ex. 1003 ¶¶ 74, 80 ("would have led to the predictable result of more accurate and convenient data transmission without significantly altering or hindering the functions performed by Aizawa's sensor"); Ex. 1047 ¶ 39. For example, Dr. Kenny acknowledges that Aizawa already discloses adding additional emitters. Ex. 1003 ¶ 39 (citing Ex. 1006 ¶ 33). Dr. Kenny further testifies that this modification "amount[s] to nothing more than the use of a known technique [i.e., Inokawa's use of two emitters in a wrist-worn pulse detector] to improve similar devices [i.e., Aizawa's wrist-worn pulse detector] in the same way and combining prior art elements according to known methods to yield predictable results." *Id.* ¶¶ 74, 80.

Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, indicate Dr. Kenny fails to appreciate the significance of optical interference complications posed by adding a second emitter to Aizawa's device, and fails to explain how this would have been overcome. *See* PO Resp. 56–57 (citing Ex. 2007, 379:17–21, 384:16–388:16, 389:17–390:20, 394:11–395:17). We have reviewed this deposition testimony, and we conclude Patent Owner overstates its significance. It establishes, at most, that Dr. Kenny did not expressly address this issue in

his declaration (Exhibit 1003), but Dr. Kenny's opinion is that this would have been within the capability of a person of ordinary skill in the art to resolve. Based on the evidentiary record presented to us, we agree with Dr. Kenny. For example, Inokawa discloses a wrist-worn pulse sensor 1 having two emitters 21 and 23 in close proximity to each other. *See* Ex. 1008, Figs. 1–2. An artisan must be presumed to know something about the art apart from what the relied-upon references disclose. *See In re Jacoby*, 309 F.2d 513, 516 (CCPA 1962).

Dr. Madisetti's testimony opposing Dr. Kenny's foregoing opinion is premised solely on Dr. Kenny's alleged failure to explain how issues that arise from adding a second emitter to Aizawa would have been solved; Dr. Madisetti does not provide any affirmative reason why these issues would have been difficult for a person of ordinary skill in the art to solve, in the context of Aizawa's device or wrist-worn pulse sensing devices in general. *See* Ex. 2004 ¶ 88.

Thus, we conclude a person of ordinary skill in the art would have been motivated to replace Aizawa's single near infrared LED 21 with an infrared LED and a green LED, and would have had a reasonable expectation of success in doing so.

iii. "[b] a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprise at least four detectors"

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses at least four detectors 22 that detect light that has been emitted by LED 21 and attenuated by body tissue. Pet. 24–25; *see, e.g.*, Ex. 1006 ¶ 27 (disclosing that light emitted from LED 21 "is reflected by a

red corpuscle running through the artery 11 of the wrist 10 and . . . is detected by the plurality of photodetectors 22 so as to detect a pulse wave"); Ex. 1003 ¶¶ 82–83.

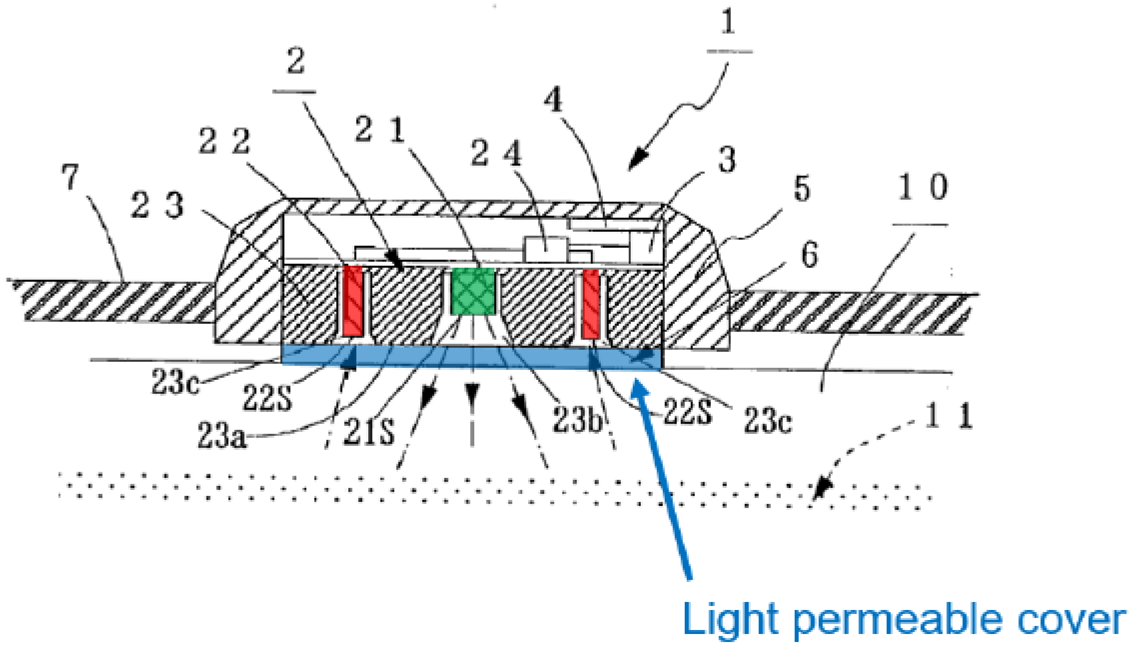
iv. *"[c] a housing configured to house at least the plurality of detectors in a circular portion of the housing"*

The cited evidence supports Petitioner's undisputed contention that Aizawa discloses holder 23, which houses the detectors in a circular portion of the housing. Pet. 25; *see, e.g.*, Ex. 1006 ¶ 23 ("holder 23 for storing . . . light emitting diode 21 and the photodetectors 22"), Figs. 1(a)–(b) (depicting circular holder 23 surrounding detectors 22).

v. *"[d] a lens configured to be located between tissue of the user and the plurality of detectors when the noninvasive optical physiological sensor is worn by the user, wherein the lens comprises a single outwardly protruding convex surface configured to cause tissue of the user to conform to at least a portion of the single outwardly protruding convex surface when the noninvasive optical physiological sensor is worn by the user and during operation of the noninvasive optical physiological sensor"*

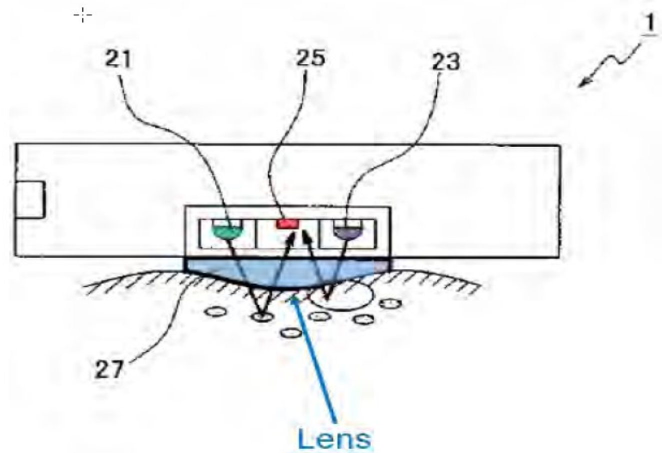
<u>Petitioner's Contentions</u>

With reference to an annotated version of Aizawa's Figure 1(b) (reproduced below), Petitioner contends that Aizawa "teaches a light permeable cover in the form of an acrylic transparent plate 6 (blue) that is mounted at the detection face 23a" of the sensor, between the user's tissue and the emitter/detector assembly. Pet. 8–9; Ex. 1003 ¶¶ 55–56.



The figure above shows Petitioner's annotated version of Aizawa's Figure 1(b), in which transparent plate 6 is shaded in blue and identified as "Light permeable cover." Petitioner contends that beyond disclosing that the acrylic transparent "helps improve 'detection efficiency,' Aizawa does not provide much other detail, for instance regarding its shape." Pet. 13 (citing Ex. 1006 ¶ 30).

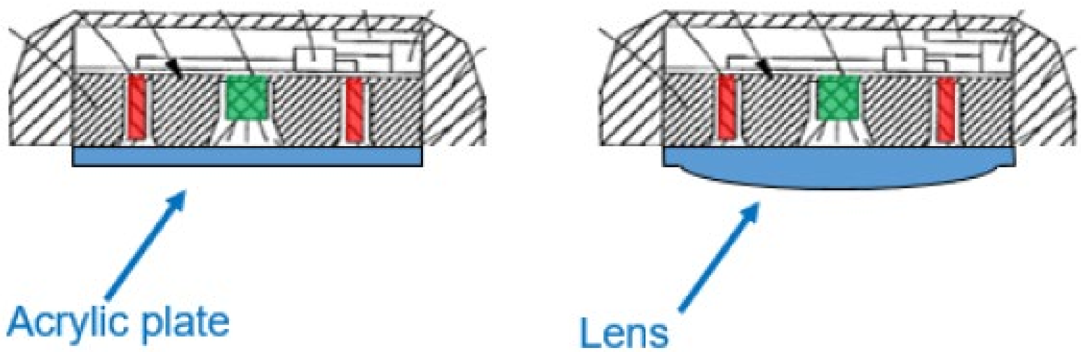
Petitioner reasons, however, that one of ordinary skill in the art would have "looked to Inokawa to enhance light collection efficiency, specifically by modifying the flat cover of Aizawa to include a convex protrusion that acts as a lens." *Id.* at 14 (citing Ex. 1003 ¶¶ 87–91), 27 ("obvious to modify the flat acrylic plate of Aizawa . . . into a lens having a single outwardly protruding convex surface . . . to further Aizawa's objective of enhancing its light-collection efficiency"). In that regard, Petitioner points to Inokawa's Figure 2. Petitioner's annotated version of that figure is reproduced below.



Id. at 14. Figure 2 above depicts Inokawa's lens 27 shaded in blue.

Petitioner expresses that "Inokawa teaches that its cover may be either flat . . . such that 'the surface is less prone to scratches'" or may be in the form of the lens shape shown above to "increase the light-gathering ability of the LED." *Id.* at 15–16 (quoting Ex. 1008 ¶ 15); *see* Ex. 1003 ¶¶ 88–91. Petitioner contends that a person of ordinary skill in the art "making the design choice to prioritize improved improved light collection efficiency over reduced suseptibility to scratches could have readily modified Aizawa's cover to include a lens as per Inokawa." Pet. 16 (citing Ex. 1003 ¶ 91). Petitioner also contends that a skilled artisan would have had a reasonable expectation of success in combining those teachings. *Id.* at 15 (citing Ex. 1003 ¶ 90). Petitioner adds that Aizawa's "transparent acrylic material . . . can be readily formed into a lens as in Inokawa." *Id.* at 16 (citing Ex. 1003 ¶ 91; Ex. 1009, 3:46–51, Fig. 1; Ex. 1023, Fig. 6, ¶¶ 22, 32, 35).

Petitioner provides annotated and modified versions of Aizawa's Figure 1(b) that depict the modification of the proposed combination, which are reproduced below. *Id.* at 15 (citing Ex. 1003 ¶ 89).



Petitioner's annotated figure on the left depicts the device with Aizawa's flat cover, and the annotated and modified figure on the right depicts the device resulting from the combination of Aizawa and Inokawa, in which a person of ordinary skill in the art would have replaced Aizawa's flat cover with a curved protrusion to "increase the light-gathering ability." *Id.* (quoting Ex. 1008 ¶ 15).

According to Petitioner, a person of ordinary skill in the art "would have understood how to implement Inokawa's lens in Aizawa's device with a reasonable expectation of success." Pet. 15 (citing Ex. 1003 ¶ 90). The shape of the modified cover in Dr. Kenny's illustration of the proposed modification above is similar to the shape of an LED lens illustrated in Exhibit 1023 (hereafter "Nishikawa"),[3] referenced by Petitioner and Dr. Kenny in connection with the proposed ground of unpatentability. *Compare* Pet. 15 (illustrating proposed modification), *with* Ex. 1023, Fig. 6, ¶¶ 3, 22, 30, 32, 35 (illustrating lens 50 used with LED 22, and discussing how to make the illustrated device); *see also* Pet. 16 (citing Ex. 1023), 50 (discussing teachings of Ex. 1023).

---

[3] U.S. Patent Application Publication No. 2007/0145255 A1, filed Dec. 20, 2006, published June 28, 2007 (Ex. 1023).

Petitioner also contends that, in the proposed modification, the convex surface of the lens will cause the user's tissue to conform because the rigid cover will be pressed against the user's skin with pressure. Pet. 28–29; Ex. 1003 ¶¶ 92–93, 98; Ex. 1006 ¶¶ 6, 23, 26, 30, 34; Ex. 1008, Fig. 2.

Patent Owner's Arguments

Patent Owner contends that the evidence does not support Petitioner's argument that it would have been obvious to modify Aizawa's cover to have a lens with an outwardly protruding convex surface, in order to improve detection efficiency by directing incoming light to Aizawa's photodetectors 22, with a reasonable expectation of success. PO Resp. 15–36; PO Sur-reply 1–13; Ex. 2004 ¶¶ 48–78.

According to Patent Owner, the evidence establishes that Petitioner's proposed modification would direct light *toward the center* of Aizawa's detector 1 where emitter 21 is located, rather than *toward the periphery* where detectors 22 are located. PO Resp. 15–23; Ex. 2004 ¶¶ 48–65. Thus, Patent Owner's view is that a person of ordinary skill in the art "would ***not*** have expected Inokawa's protruding surface to accomplish" the objective of enhancing light collection efficiency relied upon by Petitioner, because Petitioner's proposed modification instead "would direct light ***away*** from the ***periphery***-located detectors" in Aizawa, the opposite result to Petitioner's contention. PO Resp. 19; Ex. 2004 ¶¶ 42–43, 48–57.

In support, Patent Owner points to Inokawa's Figure 2, in which two arrows illustrate light that passes through the convex protrusion of lens 27 toward the center of Inokawa's pulse sensor 1 where detector 25 is located. PO Resp. 16–17 (citing Ex. 1008 ¶ 58); Ex. 2004 ¶¶ 51–52. Patent Owner also points to the '191 patent's Figure 14B, which illustrates several light

rays 1420, 1422 passing through a partially cylindrical protrusion 605 to be centrally focused on detector(s) 1410B. PO Resp. 18 (citing Ex. 1001, 36:3–6, 36:13–15; Ex. 2004 ¶¶ 53–54). Patent Owner cites portions of Dr. Kenny's deposition testimony that, in Patent Owner's view, support Patent Owner's contentions in these regards. *See* PO Resp. 2, 16–17 (citing Ex. 2006, 83:15–84:2, 86:19–87:1, 108:21–109:14, 202:11–204:20, 204:1–20).

Patent Owner also asserts that "Dr. Kenny admitted that the impact of Inokawa's convex lens would not be 'obvious' in the context of [the] different configuration of LEDs and detectors" presented by Aizawa. PO Resp. 19–20 (citing Ex. 2006, 87:2–6). For example, Patent Owner points out that "light reaching Aizawa's detectors must travel in an opposite direction from the light in Inokawa." *Id.* at 20 (Ex. 2004 ¶¶ 59–62). In addition, according to Patent Owner, "Petitioner's combination is particularly problematic because" Aizawa uses "small detectors [22] with small openings [of cavities 23c] surrounded by a ***large*** amount of ***opaque*** material." PO Resp. 21 (citing Ex. 1006, Fig. 1(a); Ex. 2004 ¶ 63). In support of its view, Patent Owner cites portions of Dr. Kenny's deposition testimony. *Id.* at 22 (citing Ex. 2006, 257:11–18). Patent Owner also argues that to account for this, "Petitioner is forced to increase the size of Aizawa's detectors approximately five-fold and eliminate Aizawa's large opaque barriers—with no analysis or explanation of such changes or the[ir] impact." *Id.* at 22–23 (citing Ex. 2004 ¶ 65).

Patent Owner further argues that Dr. Kenny, during his deposition, attempted to evade the foregoing problems by "disclaim[ing] Petitioner's reasoning [for obviousness] and assert[ing] new and improper opinions" that

undermine the reasoning provided in the Petition. PO Resp. 23. For example, Patent Owner asserts that Dr. Kenny's attempt to distinguish between the '191 patent's Figure 14B as illustrating a lens that condenses *collimated* light toward the center, as compared to Aizawa and Inokawa in which the lens focuses *diffuse* light reflected by the user's body is not persuasive and is not supported by record evidence. PO Resp. 24–25 (citing Ex. 2006, 170:9–171:5; Ex. 2007, 288:13–289:5, 294:17–298:10, 298:11–299:18, 423:7–424:18; Ex. 2004 ¶¶ 67–68). Patent Owner also objects to Dr. Kenny's testimony that, "while a protruding surface would generally direct more light to the center," it "would also capture some light that otherwise would not be captured" by Aizawa's detectors 22, as lacking evidentiary support and relying on impermissible hindsight. PO Resp. 26 (citing Ex. 1001, 7:61–63; Ex. 2004 ¶¶ 69–70; Ex. 2006, 204:21–206:5, 206:22–208:1; Ex. 2007, 294:17–298:10).

Patent Owner moreover asserts that "Dr. Kenny repeatedly distanced himself from his own similar combination" of Aizawa and Inokawa by refusing to talk about the specific shape, size, material, and dimensional tolerances of the combination, so, in Patent Owner's view, his testimony falls short because it demonstrates at most only that the references could have been combined. *Id.* at 2–3, 27–31 (citing, e.g., Ex. 2004 ¶¶ 71–73; Ex. 2006, 51:14–52:16, 75:20–77:2, 91:9–92:13, 96:20–21, 97:11–21, 100:17–101:18, 132:10–18, 154:4–7, 164:8–16, 189:11–190:3; Ex. 2007, 308:12–309:8, 310:18–311:9, 318:3–6, 324:21–325:19, 333:20–335:4).

Indeed, according to Patent Owner, because ordinary skill does not require specific education or experience with optics or optical physiological monitors (*see supra* Section II.C), "[i]t strains credibility that a [person of

ordinary skill in the art] . . . could balance all of the factors Dr. Kenny identified" to reach the claimed invention. PO Resp. 31. Patent Owner relies on Dr. Kenny's testimony as establishing the complexity of designing optical physiological sensors. *Id.* at 3–4, 31–32 (citing Ex. 2006, 86:19–87:6; Ex. 2007, 331:19–332:11, 336:11–337:15). Patent Owner concludes Petitioner has failed to establish a reasonable expectation of success because Dr. Kenny's testimony "focuses almost entirely on manufacturing." *Id.* at 32 (citing Ex. 1003 ¶ 91; Ex. 2004 ¶ 75).

Patent Owner moreover asserts Petitioner errs in relying on Nishikawa as supporting the unpatentability of claim 1 because Nishikawa is "not identified as part of" the ground, which, instead, "includes only two references," Aizawa and Inokawa. PO Resp. 33 (citing Pet. 13–14; Ex. 1003 ¶¶ 86–91); *id.* at 34–35 (citing 35 U.S.C. § 312(a)(3); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016)). Patent Owner asserts Dr. Kenny "relies heavily" on Nishikawa, particularly "to inform the specific shape of the cover in his combination, which is found nowhere in Aizawa and Inokawa." *Id.* at 33–34 (citing Ex. 2004 ¶¶ 76–77; Ex. 2006, 179:21–180:13; Ex. 2007, 364:2–13; Ex. 2008, 73:8–12).

Furthermore, in Patent Owner's view, Dr. Kenny's reliance on Nishikawa "makes no sense" because "Nishikawa's device is not a physiological sensor" but rather is "an encapsulated LED" that "directs ***outgoing*** light through the encapsulation material and thus focuses on the emission of light, not the detection of an optical signal." PO Resp. 35 (citing Ex. 1023, code (57), ¶¶ 3, 32, 35; Ex. 2004 ¶ 78). Patent Owner contrasts such disclosure with Aizawa and Inokawa, both of which "detect[] ***incoming***

light that passes through the cover and reaches the detectors," and which have a "drastically" smaller scale than Nishikawa's LEDs. *Id.* (citing Ex. 1008, Fig. 2; Ex. 2004 ¶ 78).

Petitioner's Reply

In reply, Petitioner insists "Inokawa's lens enhances the light-gathering ability of Aizawa," which would have motivated an ordinarily skilled artisan "to incorporate 'an Inokawa-like lens [having a protrusion] into the cover of Aizawa to increase the light collection efficiency.'" Pet. Reply 2–3 (bolding omitted) (citing Pet. 13–15; Ex. 1003 ¶¶ 86–89; Ex. 1008, Fig. 2, ¶¶ 15, 58). Petitioner dismisses Patent Owner's and Dr. Madisetti's opposition as being "misinformed" because a person of ordinary skill in the art "would understand that Inokawa's lens generally improves 'light concentration at pretty much all of the locations under the curvature of the lens,' as opposed to only at a single point at the center." *Id.* at 3 (quoting Ex. 2006, 164:8–16); Ex. 1047 ¶¶ 7–9.

For example, Petitioner contends that Patent Owner and Dr. Madisetti "ignore[] the well-known principle of reversibility," by which "a ray going from P to S will trace the same route as one from S to P." Pet. Reply 4 (underlining omitted) (citing, e.g., Ex. 1052,[4] 84, 87–92); Ex. 1047 ¶¶ 10–22. Petitioner contends that Dr. Madisetti was evasive when he was asked to apply the reversibility principle to the combination of Aizawa and Inokawa in this case. Pet. Reply 6 (citing Ex. 1034, 89:12–19). Petitioner further

[4] Eugene Hecht, *Optics* (2nd ed. 1990). In referring to Exhibit 1052, Petitioner refers to the document's native page numbering (top corner of each page) and not the added page numbering of the exhibit (bottom, middle of each page). For consistency, we also refer to the native page numbering of Exhibit 1052.

contends that, "based at least on the principle of reversibility," one of ordinary skill in the art "would have understood that both configurations of LEDs and detectors—i.e., with the LED at the center as in Aizawa or with the detector at the center as in Inokawa—would similarly benefit from the enhanced light-gathering ability of an Inokawa-like lens." *Id.* at 9 (citing Ex. 1047 ¶ 22).

Petitioner also asserts that Patent Owner and Dr. Madisetti overlook the fact that light rays reflected by body tissue in the user's wrist, to be received by detectors in either Aizawa's or Inokawa's pulse sensor, will be "scattered" and "diffuse" and, therefore, will approach the detectors "from various random directions and angles." Pet. Reply 9–10, 13 (annotating Inokawa's Fig. 2 to illustrate the cause and nature of the back-scattering); Ex. 1047 ¶¶ 23–26. This scattered and diffuse light, according to Petitioner, means that Inokawa's "lens cannot focus all light toward the sensor's center," as Patent Owner would have it. Pet. Reply 9 (citing Ex. 1047 ¶ 23; Ex. 2006, 163:12–164:2). Petitioner asserts this is due to Snell's law, and provides several illustrations to illustrate why. *Id.* at 9–15 (citing, e.g., Ex. 1047 ¶¶ 23–34).

Due to the random nature of this scattered light, Petitioner explains that one of ordinary skill in the art would have understood that a convex cover "provides a slight refracting effect, such that light rays that may have missed the detection area are instead directed toward that area." Pet. Reply 10 (citing Ex. 1047 ¶¶ 25–26). Petitioner applies this understanding to Aizawa, and contends that using a lens with a convex protrusion in Aizawa would "enable backscattered light to be detected within a circular active detection area surrounding" a central light source. *Id.*

Moreover, Petitioner dismisses the applicability of Figure 14B of the ’191 patent as illustrating the operation of a *transmittance*-type of sensor that measures the attenuation of collimated light transmitted through the user’s body tissue, rather than the *reflectance*-type sensor of Aizawa. *Id.* at 11–13 (citing, e.g., Ex. 1001, 36:11–13; Ex. 1047 ¶¶ 27–31).

Petitioner further maintains that Patent Owner’s argument that Petitioner’s illustrations of the light-focusing properties of a convex lens discussed in the Petition filed in IPR2020-01520 (Ex. 2019, 39) and relied upon by Dr. Kenny (Ex. 2020 ¶¶ 119–120) do not demonstrate “that a convex lens directs all light to the center.” Pet. Reply 15 (citing PO Resp. 16–18, 23). Petitioner contends these illustrations, instead, “are merely simplified diagrams included to illustrate . . . one example scenario (based on just one ray and one corpuscle) where a light permeable cover can ‘reduce a mean path length of light traveling to the at least four detectors’” as recited in claim 12 of the patent challenged in that proceeding. *Id.* (citing, e.g., Ex. 1047 ¶ 34).

<u>Patent Owner’s Sur-reply</u>

Patent Owner asserts that Petitioner’s Reply improperly presents several new arguments, relying on new evidence, as compared with the Petition. *See, e.g.*, PO Sur-reply 1 (“new optics theories” and “new arguments”), 2, 6, 7, 9, 10, 12, 13.

Patent Owner also contends that Petitioner mischaracterizes Patent Owner’s position, which is not that Inokawa’s lens with a convex protrusion “would direct ‘***all***’ light ‘only at a ***single point*** at the center’” of the sensor. *Id.* at 2, n.2 (quoting Pet. Reply 3; citing, e.g., Ex. 2027, 63:7–64:6, 94:20–96:1, 96:18–97:7). Patent Owner’s position, rather, is that Inokawa’s lens

condenses more light (not necessarily all light) "***towards the center*** of the sensor" as compared to a flat surface. *Id.* at 2 (quoting PO Resp. 18; citing, e.g., Ex. 2004 ¶¶ 34, 43, 49, 51–52, 54–55, 67).

Patent Owner moreover asserts "[t]here can be no legitimate dispute that a convex surface directs light centrally (and away from the periphery)." PO Sur-reply 3–6 (citing PO Resp. 15–18; Ex. 2006, 164:8–16, 166:10–17, 170:22–171:5; Ex. 2020 ¶¶ 119, 200; Ex. 2027, 181:9–182:5). Patent Owner contends that Petitioner's argument "that Inokawa would improve light-gathering at all locations, ***regardless*** of the location of the LEDs and detectors" is belied by Dr. Kenny's testimony that "Inokawa's benefit would ***not*** be clear if Inokawa's LEDs and detectors were moved" and "confirmed that a convex surface would direct light toward the center of the underlying sensor." *Id.* at 6 (citing Pet. Reply 3–4; Ex. 2006, 86:19–87:6, 202:11–204:20).

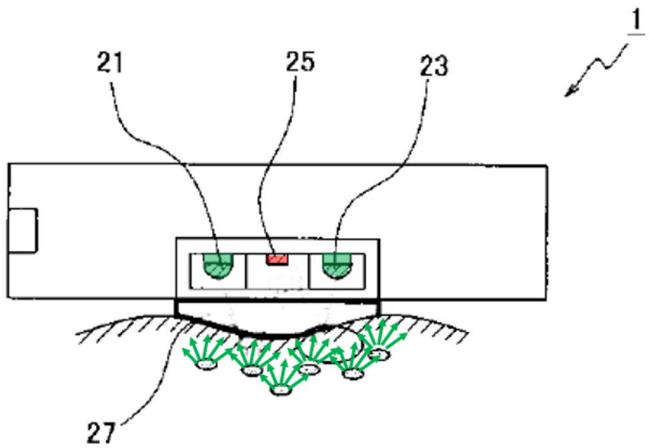
Patent Owner argues that Petitioner's discussion of the principle of reversibility is "irrelevant" because it "assumes ideal conditions that are not present when tissue scatters and absorbs light." PO Sur-reply 6–8 (citing Ex. 2027, 17:12–19:2, 29:11–30:7, 31:8–32:3, 38:17–42:6, 207:9–209:21, 210:8–6). The random nature of backscattered light, in Patent Owner's view, "hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed," and is irrelevant to the central issue presented here of "whether a convex surface—***as compared with a flat surface***—would collect and focus additional light on Aizawa's peripherally located detectors." *Id.* at 8–9 (citing Ex. 2027, 212:3–14).

Patent Owner also argues that Petitioner's position that a convex cover will provide a "***slight***" refracting effect, "directly undermines Petitioner's provided ***motivation*** to combine," i.e., to enhance light collection efficiency. *Id.* at 10–11.

Analysis

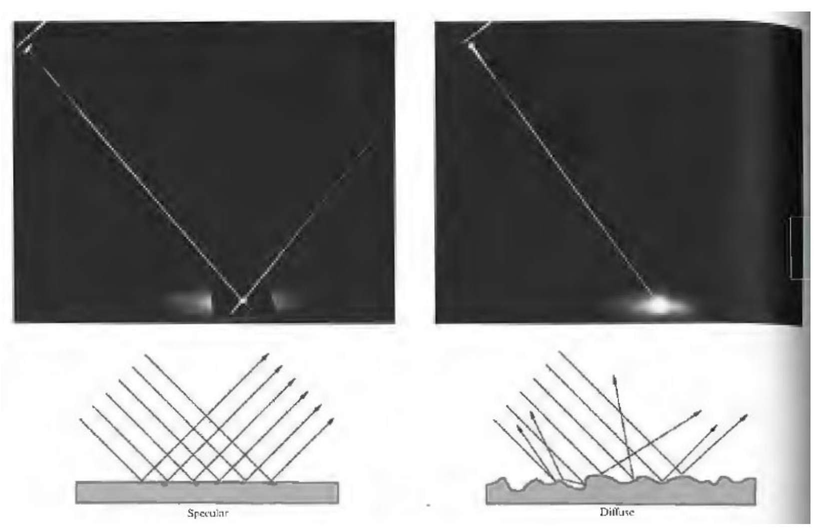
Upon review of the foregoing, we conclude that a preponderance of the evidence supports Petitioner's view that it would have been obvious to modify Aizawa's cover 6 to include a lens with a single outwardly protruding convex surface like that taught in Inokawa, in order to increase the amount of backscattered light that will be received by Aizawa's four peripheral detectors 22, as compared with Aizawa's existing flat cover.

It is clear that Aizawa's and Inokawa's pulse sensors both gather data by emitting light into the user's wrist tissue and collecting light that reflects back to the sensor from the user's tissue. *See, e.g.*, Ex. 1006, Figs. 1(b), 2 (sensor 2 has emitter 21 and four detectors 22, all facing a user's wrist 10); Ex. 1008, Figs. 1, 2 (sensor 1 has two emitters 21, 23 and one detector (photodiode 25), all facing the user's wrist when held in place by wristband 5). Dr. Kenny testifies, and Patent Owner agrees, that the reflection of this light by the user's wrist tissue randomizes the propagation direction of the reflected light rays. *See* Ex. 1047 ¶¶ 12, 14–17, 23; Ex. 2020 ¶ 128; PO Sur-reply 7 ("Even Petitioner admits that tissue randomly scatters and absorbs light rays . . . ."). This reflection principle is illustrated by Dr. Kenny's annotations to Inokawa's Figure 2 reproduced below:



Here, Dr. Kenny has modified Inokawa's Figure 2 by (1) removing two black arrows, (2) coloring Inokawa's light detector in red and Inokawa's two light emitters in green, and (3) adding several green arrows to illustrate the various directions that light rays may be directed after impinging on and reflecting off different tissues in the user's wrist. Ex. 1047 ¶ 32.

This randomized direction of reflected light rays results in backscattered light that is diffuse, rather than collimated, in nature. Figure 4.12 of Exhibit 1052 illustrates the difference between diffuse and collimated light, and is reproduced below:



This figure provides at left a photograph and an illustration showing incoming collimated light reflecting from a smooth surface, and at right a

photograph and an illustration of incoming collimated light reflecting from a rough surface. *See* Ex. 1052, 87–88. The smooth surface provides specular reflection, in which the reflected light rays are collimated like the incoming light rays. *See id.* The rough surface provides diffuse reflection, in which the reflected light rays travel in random directions. *See id.*

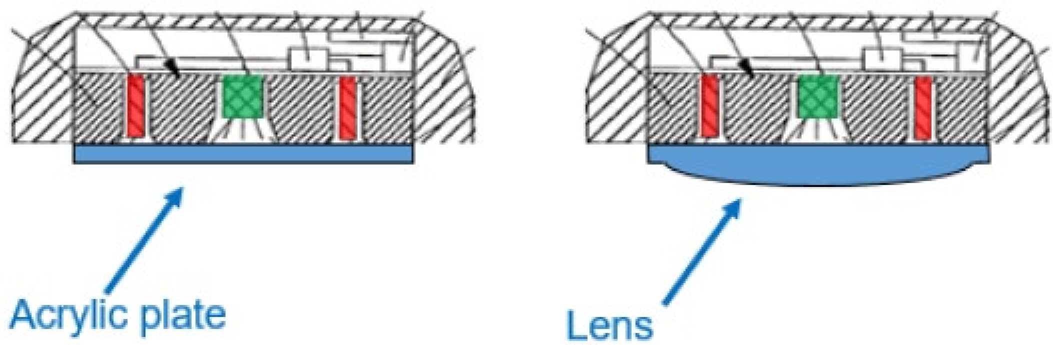
This diffuse nature of the light reflected from the user's wrist tissue, which both Aizawa and Inokawa aim to collect to generate pulse data, suggests that a lens might be useful to increase the amount of collected light and thereby increase the reliability of the pulse data generated using the collected light. Indeed, that is taught by Inokawa. Inokawa describes using its lens 27 to "increase the light-gathering ability" of Inokawa's light photodiode or detector 25.[5] Ex. 1008 ¶¶ 15, 58. Furthermore, there is also no dispute that Inokawa's lens 27 is understood to be shaped to include a single convex protruding surface. *See, e.g.*, Ex. 1003 ¶¶ 87–88 (characterizing Inokawa as teachings a "convex protrusion that acts as a lens"); PO Resp. 1 (describing Inokawa as teaching a "convex lens"). Thus, Inokawa demonstrates that it was known in the art to use a lens comprising a single convex protrusion to focus diffuse light reflected from body tissue on to the light detecting elements of a wrist-worn pulse sensor, and to increase the light gathered by the sensor thereby improving the device's calculation of the user's pulse.

A preponderance of the evidence supports Petitioner's view that it would have been obvious for a person of ordinary skill in the art to apply

---

[5] Although Inokawa refers to the "LED" such as emitters 21, 23 in that regard (Ex. 1008 ¶ 15), rather than photodiode 25, it is undisputed that photodiode 25 is the only component of Inokawa's sensor 1 that gathers light.

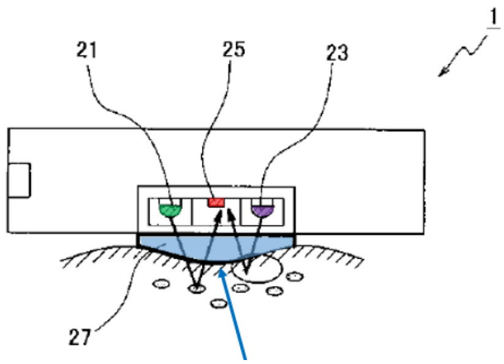
Inokawa's lens technology to Aizawa's wrist-worn pulse sensor to similarly improve its light collection as compared to Aizawa's existing flat cover. That is depicted in the following illustrations provided by Dr. Kenny:

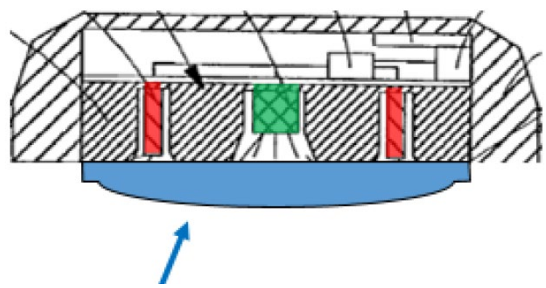


The illustration at left modifies Aizawa's Figure 1(b) to color Aizawa's emitter in green, its detectors in red, and Aizawa's existing flat cover in blue; the illustration on the right includes Aizawa's Figure 1(b) with the same color coding, but wherein the flat cover is modified to incorporate a convex protrusion that covers Aizawa's peripheral light detectors and central light emitter. *See* Ex. 1003 ¶ 89. We are persuaded by Dr. Kenny's testimony that Snell's law indicates that "light rays that may have otherwise missed the detection area are instead directed toward that area as they pass through the interface provided by the cover," and is especially true "in configurations like Aizawa's in which light detectors are arranged symmetrically about a central light source, so as to enable backscattered light to be detected within a circular active detection area surrounding that source." Ex. 1047 ¶ 26; *see also id.* ¶¶ 23–26.

Patent Owner correctly notes that Inokawa's single detector 25 is located in the central portion of Inokawa's sensor 1, whereas Aizawa's four detectors 22 are located towards the periphery of Aizawa's sensor 2. *Compare* Ex. 1008, Fig. 2, *with* Ex. 1006, Figs. 1(a)–1(b). Nevertheless,

Petitioner's proposed modification of Aizawa takes that arrangement into account, as can be seen by the following comparison between Inokawa's sensor and Petitioner's proposed modification of Aizawa's sensor:





The illustration at left annotates Inokawa's Figure 2 to identify the central detector in red and the lens in blue (*see* Ex. 1003 ¶ 87), and the illustration at right annotates Petitioner's proposed modification of Aizawa to illustrate the peripheral detectors in red and the lens in blue (*see id.* ¶ 89). As can be seen, the lenses are not identical. In Inokawa the lens's curvature is most pronounced at the center of the lens near the central detector, and in the proposed modification to Aizawa, the lens's curvature is most pronounced at the edges of the lens near the peripheral detectors. Thus, Dr. Kenny's proposed modification of Aizawa takes Inokawa's general teaching of using a convex protruding lens to increase the amount of incoming light directed to a light detector, and applies it to the light detectors of Aizawa. *See, e.g.*, Ex. 1003 ¶ 88 ("[B]ecause the path of light is reversible, the light collection function of Inokawa's lens would work the same way regardless of whether light is emitted toward the center (and detected by a centrally located photodiode) or emitted away from the center (and detected by a peripherally located photodiode)."), 90 ("That is, depending on the desired objective of the user (e.g., less scratches or improved light-gathering), the shape of the cover can be readily modified."), 91 ("[T]o achieve the goal of

improving light collection efficiency, which both Aizawa and Inokawa share, a [person of ordinary skill in the art] would have been able to, with a reasonable expectation of success, modify Aizawa's light permeable cover to have a lens as taught by Inokawa."); Ex. 1047 ¶¶ 7–34.

We are cognizant of Patent Owner's contention that Petitioner's ground "improperly" relies upon a reference, Nishikawa, that was not identified as a part of the ground of unpatentability. PO Resp. 33. As Patent Owner observes, Dr. Kenny characterizes his testimony as being "***inspired*** by" or "motivated" in part based on Nishikawa's disclosure when it comes to the shape of a convex lens. *See, e.g.*, PO Resp. 34–36 (citing, e.g., Ex. 2007, 364:2–13; Ex. 2008, 73:8–12). We, however, disagree with Patent Owner that any impropriety arises from Dr. Kenny's contemplation of the teachings of Nishikawa in connection with the shape of a lens for a physiological sensor. The nature of Petitioner's and Dr. Kenny's consideration of Nishikawa is explained in cited portions of Dr. Kenny's declaration, even if Nishikawa is not listed as a third reference in the identification of the ground. *See* Ex. 1003 ¶ 91 ("[M]any prior art references of this period, such as Nishikawa (shown below) demonstrate exactly how such a lens shape [as taught by Inokawa] may be incorporated into a molded cover."); Pet. 16. Indeed, it follows readily from the Petition that a skilled artisan would have appreciated that Nishikawa's teachings provide insight as to how "the transparent acrylic material used to make Aizawa's plate can be readily formed into a lens structure as in Inokawa." Pet. 16. Nishikawa describes how its "lens unit 50" can be a transparent resin formed in the shape illustrated in Figure 6 by injection molding. Ex. 1023 ¶¶ 22, 32, 35. Dr. Kenny also explains that Nishikawa's lens shape design "is intended to

provide curvature in the lens where it can do the most good and otherwise try to avoid excess use of material in order to create curvature in locations where it wouldn't do any good." Ex. 2006, 179:21–180:13.

Moreover, we observe that a rejection based on obviousness "require[s] an analysis that reads the prior art in context, taking account of 'demands known to the design community,' 'the background knowledge possessed by a person having ordinary skill in the art,' and 'the inferences and creative steps that a person of ordinary skill in the art would employ.'" *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (quoting *KSR*, 550 U.S. at 418). Furthermore, record evidence can be useful to "demonstrate the knowledge and perspective one of ordinary skill in the art." *Id.*; *see also Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1365 (Fed. Cir. 2015) ("Art can legitimately serve to document the knowledge that skill artisan would bring to bear in reading the prior art identified as producing obviousness.").

As noted above, Dr. Kenny makes clear that his view as to obviousness of the claims of the '191 patent was "inspired by" or "motivated" in part by Nishikawa's teachings as to shapes generally known to those in the art of manufacturing a lens. *See, e.g.*, Ex. 2007, 364:2–13; Ex. 2008, 73:12–21. We conclude that the record establishes that Nishikawa's teachings are representative of background knowledge of one of ordinary skill in the art and provide context and perspective of a skilled artisan as to the type of shapes available for a convex protruding surface, such as that disclosed in Inokawa. That Dr. Kenny considered record evidence cited in the Petition as informing his view of what a skilled artisan

would understand as to known types of lens shapes does not establish, in our view, any impropriety as part of that ground.

Patent Owner additionally asserts, and Dr. Madisetti testifies, that Petitioner's combination of Aizawa and Inokawa is "problematic" because it overlooks the "small" size of Aizawa's detectors 22 and the openings or cavities 23c in which they are housed. *See* PO Resp. 21 (citing Ex. 1006, Fig. 1(a); Ex. 2004 ¶ 63). Patent Owner, however, does not articulate what significance the size of Aizawa's detector components have in the obviousness evaluation based on the teachings of the prior art.

We additionally do not agree with Patent Owner's argument that Petitioner's Reply presents new arguments and evidence that should have been first presented in the Petition. The Petition proposed a specific modification of Aizawa to include a convex protrusion in the cover, for the purpose of increasing the light gathering ability of Aizawa's device. *See, e.g.*, Pet. 13–17. Patent Owner, in its Response, challenged that contention with several arguments that Petitioner's proposed convex protrusion would not operate in the way the Petition alleged. *See, e.g.*, PO Resp. 15–36. In its Reply, Petitioner provided arguments and evidence attempting to rebut the contentions in the Patent Owner Response. *See* PTAB Consolidated Trial Practice Guide (Nov. 2019),[6] 73 ("A party also may submit rebuttal evidence in support of its reply."). The Reply does not change Petitioner's theory for obviousness; rather, the Reply presents more argument and evidence in support of the same theory for obviousness presented in the Petition. *Compare* Pet. 13–17, *with* Pet. Reply 2–15.

[6] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

Patent Owner finally argues that a conclusion of obviousness "strains credibility" because the level of ordinary skill in the art (*see supra* Section II.C) does not require specific education or experience with optics or optical physiological monitors. *See, e.g.*, PO Resp. 31. We disagree. Concerning motivation, the record demonstrates that an ordinarily skilled artisan would have readily appreciated that: (1) Aizawa's detector 1 operates by gathering light data with its photodetectors 22; (2) a lens was known to focus light on photodetectors; and (3) optical lenses may be formed by providing a convex protrusion in the lens to focus light. Indeed, Inokawa discloses such utility, function, and structure as a part of its convex lens. *See, e.g.*, Ex. 1008 ¶¶ 15, 58, Fig. 2. We are persuaded that a person of ordinary skill in the art would have understood these general concepts of optics.

Concerning reasonable expectation of success, we rely on Dr. Kenny's testimony that a person of ordinary skill in the art "would have sought to incorporate a convex lens as in Inokawa into Aizawa's acrylic plate to thereby increase light collection efficiency, in turn leading to more reliable pulse wave detection," "would have further understood *how* to" do so, "depending on the desired objective of the user," and would have enjoyed a reasonable expectation of success in doing so. Ex. 1003 ¶¶ 88, 90–91; Ex. 2006, 179:21–180:13, 202:11–20.

Thus, we conclude that one of ordinary skill in the art would have had adequate reason to replace Aizawa's flat cover 6 with a cover comprising a convex protrusion, to improve light detection efficiency, and would have had a reasonable expectation of success in doing so.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

4. Independent Claim 9

Independent claim 9 consists of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:50–67, *with id.* at 45:26–36 (reciting a "planar surface"; "at least four detectors" arranged in a "grid pattern" on the planar surface; and "a lens forming a cover of the housing"). In asserting that claim 9 also would have been obvious over the combined teachings of Aizawa and Inokawa, Petitioner refers to substantially the same arguments presented as to claim 1. *See* Pet. 35–38; Ex. 1003 ¶¶ 106–113.

Patent Owner does not present any argument for this claim other than those we have already considered with respect to independent claim 1. PO Resp. 12–42.

For the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 9 would have been obvious over the cited combination of references. *See supra* II.D.3.i–v; Ex. 1003 ¶¶ 106–113.

5. Dependent Claims 2–6, 8, 10–16, 18, and 19

Petitioner presents undisputed contentions that claims 2–6, 8, 10–16, 18, and 19, which depend directly or indirectly from independent claim 1 or 9, are unpatentable over the combined teachings of Aizawa and Inokawa,

and provides arguments explaining how the references teach the limitations of these claims. Pet. 29–34, 38–43; Ex. 1003 ¶¶ 94–105, 114–124.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 42 ("The Petition fails to establish that independent claims 1 and 9 would have been obvious . . . and thus fails to establish obviousness as to any of the challenged dependent claims.").

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–6, 8, 10–16, 18, and 19 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

E. Obviousness over the Combined Teachings of Mendelson-1988 and Inokawa

Petitioner contends that claims 1–6, 8–16, 18, and 19 of the '191 patent would have been obvious over the combined teachings of Mendelson-1988 and Inokawa. Pet. 46–70.

1. Overview of Mendelson-1988 (Ex. 1015)

Mendelson-1988 discloses a pulse oximeter, with an optical reflectance sensor suitable for noninvasive monitoring of a user's arterial hemoglobin oxygen saturation (SpO_2), via the user's forehead. *See* Ex. 1015, 167 (title & abstract). Figure 2 is reproduced below:

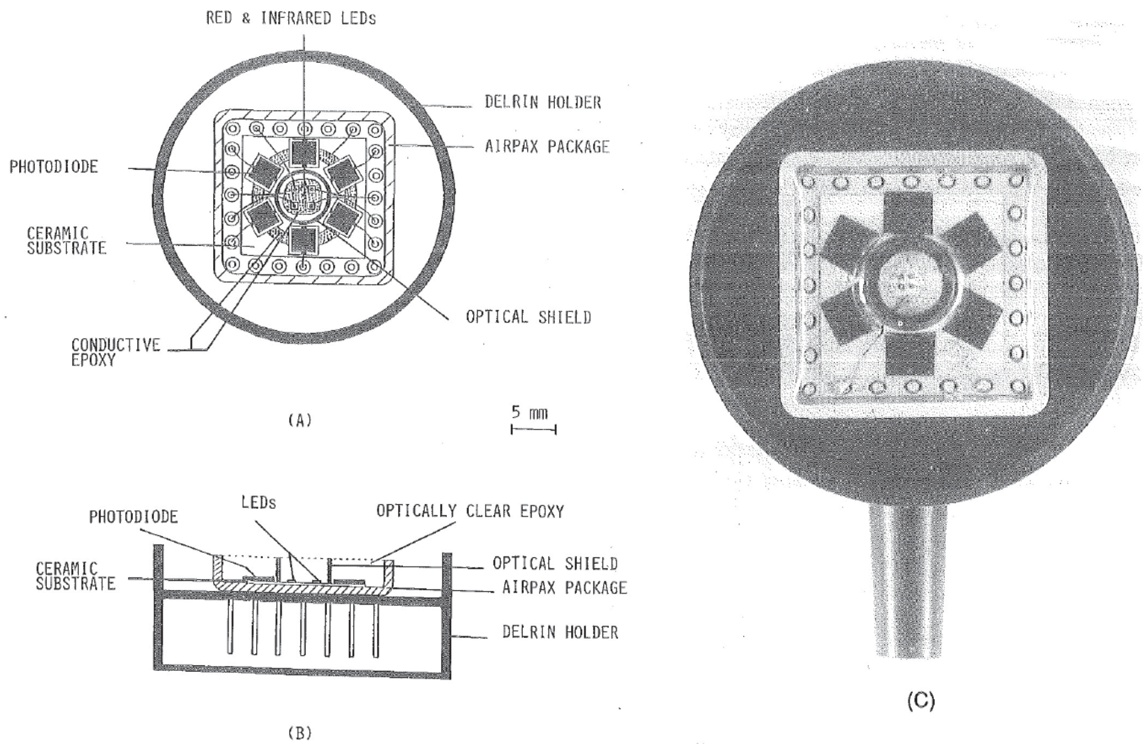


Figure 2 illustrates the sensor of Mendelson-1988, including: (A) a top view diagram; (B) a side view diagram; and (C) a photograph. *Id.* at 169.

The sensor includes two red LEDs and two infrared LEDs for emitting light into the user's tissue, and six photodiodes "arranged symmetrically in a hexagonal configuration" surrounding the four emitters, to detect light reflected back to the sensor from the user's tissue. *Id.* at 168 ("SENSOR DESIGN"). The user's "SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms." *Id.* at 167. "To minimize the amount of light transmission and reflection between the LEDs and the photodiodes within the sensor, a ring-shaped, optically opaque shield of black Delrin . . . was placed between the LEDs and the photodiode chips." *Id.* at 168 (col. 2). "The optical components were encapsulated inside the package using optically clear adhesive." *Id.* "The microelectronic package was mounted inside a black Delrin housing." *Id.*

2. Independent Claim 1

Petitioner contends that claim 1 would have been obvious over the combined teachings of Mendelson-1988 and Inokawa. Pet. 47–51 (combination), 51–56 (claim 1).

i. "A noninvasive optical physiological sensor comprising"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses a noninvasive optical physiological sensor, i.e., an "optical reflectance sensor" that monitors "arterial hemoglobin oxygen saturation," a physiological parameter of the wearer. Pet. 51; *see, e.g.*, Ex. 1015, Abstract, 167, 172; Ex. 1003 ¶ 130.

ii. "[a] a plurality of emitters configured to emit light into tissue of a user"

The cited evidence supports Petitioner's undisputed contention that Mendelson-1988 discloses two red LEDs and two infrared LEDs that emit light into user tissue. Pet. 51; *see, e.g.*, Ex. 1015, 168 ("The optical reflectance sensor used in this study consists of two red (peak emission wavelength: 660 nm) and two infrared (peak emission wavelength: 930 nm) LED chips.")), Fig. 2(a); Ex. 1003 ¶ 131.

iii. "[b] a plurality of detectors configured to detect light that has been attenuated by tissue of the user, wherein the plurality of detectors comprise at least four detectors"

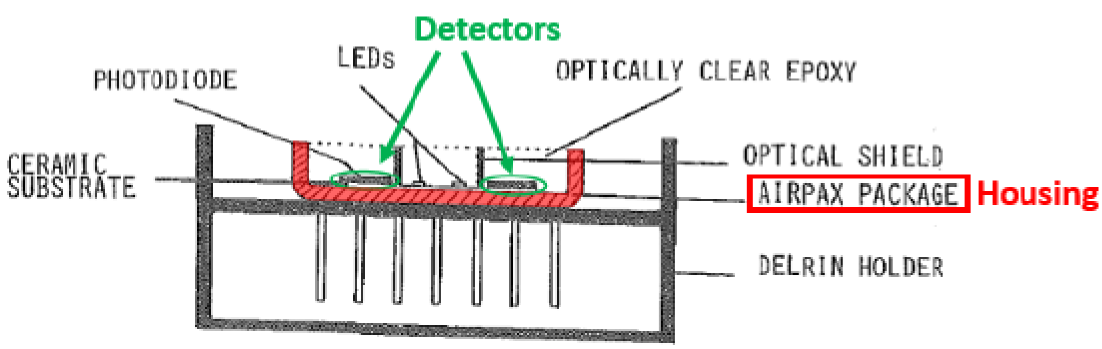
The cited evidence supports Petitioner's undisputed contention that Mendelson-1998 discloses "six silicon photodiodes . . . arranged symmetrically in a hexagonal configuration" on the sensor. Pet. 52; *see,*

e.g., Ex. 1015, 168–169, Figs. 2(A)–(B). Mendelson-1998 discloses that the photodiodes output "current pulses" indicative of a physiological parameter of the wearer in response to light emitted by the emitters and reflected from the skin. Pet. 52; *see, e.g.*, Ex. 1015, 167 ("SpO_2 can be calculated from the ratio of the reflected red and infrared photoplethysmograms."); Ex. 1003 ¶ 132.

iv. "[c] a housing configured to house at least the plurality of detectors in a circular portion of the housing"

<u>Petitioner's Undisputed Contentions</u>

The cited evidence supports Petitioner's contention that Mendelson-1988 discloses an AIRPAX package, i.e., a housing in which the detectors are located. Pet. 60; Ex. 1015, 168. Petitioner's annotated version of Mendelson-1988's Figures 2B is reproduced below.



Pet. 53. The modified figure depicts a side view of Mendelson-1988's sensor with a housing (depicted in red) in which the detectors (depicted in green) are located. *Id.*; Ex. 1003 ¶ 133.

<u>Petitioner's Disputed Contentions</u>

Petitioner contends that although the housing of Mendelson-1998 appears to have a square shape, not a circular one, a person of ordinary skill

in the art "would have recognized that microelectronic packaging as used in Mendelson-1988 comes in various shapes and sizes," and that such an artisan "would have considered using a differently shaped housing, namely a circular one, to be obvious" because a circular housing was common and the shape would have imparted nothing new or inventive. Pet. 54–55 (citing, e.g., Ex. 1003 ¶¶ 134–135). For example, Petitioner relies on Mendelson-799,[7] which discloses a sensor for an optical measurement device having a circular shape. *Id.* (citing Ex. 1025, Fig. 7, 9:34–36).

Patent Owner's Arguments

Patent Owner argues that Mendelson-1988 and Inokawa provide square housings for their components. PO Resp. 52–53. According to Patent Owner, "[t]he Petition never identifies a motivation to pick a circular-shaped housing instead of the existing square shape" and that a skilled artisan would not have made such a modification without some perceived benefit for doing so. *Id.* at 53–54 (citing, e.g., Ex. 2004 ¶ 118). Patent Owner objects to Petitioner's reliance on the sensor shape taught by Mendelson-799 because (1) Mendelson-799 is not included in any ground, and (2) Mendelson-799 does not disclose a cover and, as such, cannot disclose the combined claim features. *Id.* at 54.

Petitioner's Reply

In its Reply, Petitioner contends that "neither the '191 patent nor [Patent Owner] provides any explanation of how the particular housing shape solves some problem or presents some unexpected result." Pet. Reply 26.

---

[7] U.S. Patent No. 6,801,799 B2 ("Mendelson-799," Ex. 1025).

Patent Owner's Sur-reply

In its Sur-reply, Patent Owner reiterates its positions from its Response. PO Sur-reply 23.

Analysis

We are persuaded by Petitioner's contentions. Mendelson-1988 discloses a housing in the form of an AIRPAX package that has a square shape when viewed from above. *See* Ex. 1015, Fig. 2(A). Petitioner's and Dr. Kenny's general assessment that a person of ordinary skill in the art would have been aware that a circular housing shape was a known option for housing components of a physiological sensor finds support in the record. Pet. 53–55; Ex. 1003 ¶¶ 133–135. In that respect, although Mendelson-799 was not listed in the styling of the proposed grounds of unpatentability based on Mendelson-1988 and Inokawa, its teachings plainly were offered in the Petition as evidence of the background knowledge that an ordinarily skilled artisan would have brought to bear in an evaluation of the teachings Mendelson-1988 and Inokawa. Pet. 54. Moreover, it is clear that Patent Owner understood that the proposed ground offered in the Petition considered the disclosure of Mendelson-799, and Patent Owner had opportunity to address that disclosure. Indeed, Patent Owner availed itself of that opportunity during trial (*see, e.g.*, PO Resp. 52–54; PO Sur-reply 23).

We further find unavailing Patent Owner's argument that "Mendelson[-]799 does not disclose a cover (or even epoxy encapsulation)." PO Resp. 54. Figure 7 of Mendelson-799 is reproduced below:

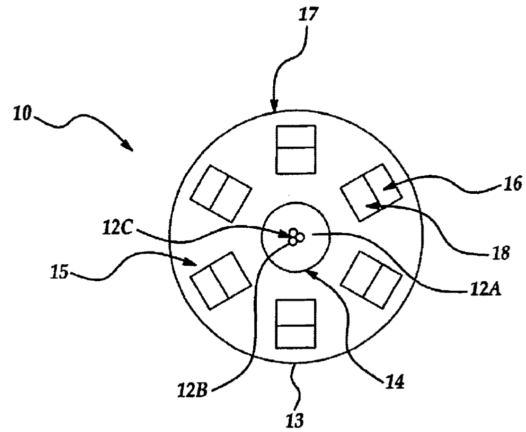


Figure 7

Figure 7 is a top view of optical sensor 10 comprising light source 12 composed of three LEDs 12A, 12B, and 12C emitting light of three different wavelengths, and an array of six near detectors 18 and six far detectors 16 "arranged in two concentric ring-like arrangements" surrounding light source 12. Ex. 1025, 9:23–34. "All these elements are accommodated in a sensor housing 17" which, as can be seen in Figure 7, is clearly circular. *Id.* at 9:34–35. Patent Owner does not articulate why the presence or absence of a cover in Mendelson-799 somehow serves to discount the unambiguous presentation of a sensor housing having a circular shape.

Furthermore, one of ordinary skill in the art would have understood that the AIRPAX package of Mendelson-1988 and the housing 17 of Mendelson-799 are performing the same function of enclosing a central collection of light emitters which are surrounded by an array of light detectors in an optical sensor attached to a user's body. *See, e.g.*, Ex. 1015, Figs. 2A–2B; Ex. 1025, Fig. 7. The evidence of record also does not suggest that the shape of such a housing has any functional significance in the operation of the optical sensor, or that any particular known shape was preferred or restricted. Thus, the evidence suggests that a square shape and a circular shape of such a housing were known in the art to be predictable

substitutes for one another, and therefore obvious variants. *See, e.g.*, *KSR*, 550 U.S. at 416 ("[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result."); *id.* at 417 ("[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." (citation omitted)).

Thus, we conclude a person of ordinary skill in the art would have found it obvious to modify the square shape of Mendelson-1988's sensor to be circular, and would have had a reasonable expectation of success in doing so.

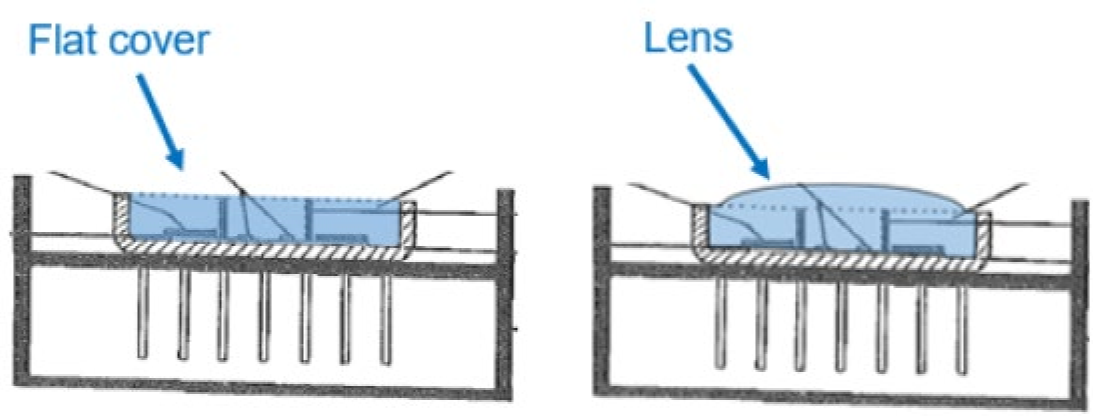
v. "[d] a lens configured to be located between tissue of the user and the plurality of detectors when the noninvasive optical physiological sensor is worn by the user, wherein the lens comprises a single outwardly protruding convex surface configured to cause tissue of the user to conform to at least a portion of the single outwardly protruding convex surface when the noninvasive optical physiological sensor is worn by the user and during operation of the noninvasive optical physiological sensor"

<u>Petitioner's Contentions</u>

Petitioner contends that Mendelson-1988's sensor discloses a light permeable cover, i.e., the "OPTICALLY CLEAR EPOXY" in Figure 2B, that covers the detectors and is located between the user's tissue and the detectors when worn. Pet. 47, 55–56; Ex. 1003 ¶¶ 67, 136–145. Petitioner states that Mendelson-1998 does not provide further details, such as the "precise shape of this layer's interface with the skin." Pet. 47; Ex. 1003

¶ 137. As discussed above in Section II.D.3, Petitioner contends that Inokawa's sensor includes lens 27 positioned over light detector 25. Pet. 65. Petitioner reasons that an ordinarily skilled artisan would have been motivated, with a reasonable expectation of success, to modify Mendelson-1988's optical SpO_2 sensor, in light of Inokawa's optical pulse sensor, by adding a lens with a single outwardly protruding convex surface to Mendelson-1988's cover to improve the sensor's light detection efficiency. *Id.* at 48–49.

Dr. Kenny provides the following illustrations to portray the proposed modification of Mendelson-1988's sensor (Ex. 1003 ¶¶ 140–141):



At the left, Dr. Kenny has excerpted and annotated Mendelson-1988's Figure 2B, to identify the pre-existing cover (colored blue) which covers the light emitters and detectors. *See id.* At the right, Dr. Kenny has illustrated the device resulting from the proposed modification of the cover to have a single convex protrusion (also colored blue). *See id.*

Petitioner adds that a person of ordinary skill in the art would have had a reasonable expectation of success in implementing Inokawa's lens structure in Mendelson-1998, and that the modification would have "require[d] only routine knowledge of sensor design and assembly."

Pet. 59–60; Ex. 1003 ¶ 142. For example, Petitioner contends that prior art to Nishikawa demonstrates that "molding clear epoxy, as in Mendelson-1988, into a lens was well understood." Pet. 50 (citing Ex. 1023, Fig. 6, ¶¶ 22, 32, 35; Ex. 1003 ¶ 143). Indeed, Petitioner notes that Mendelson-1998 and Nishikawa utilize the same material, which "can have the same index of refraction, and, as such, the interface between the encapsulation portion and the lens portion will not adversely affect the optical performance of the modified system." *Id.* (citing Ex. 1023 ¶ 37; Ex. 1003 ¶ 144).

Finally, Petitioner contends that "[a]ttaching a rigid device," as suggested by the proposed combination of Mendelson-1998 and Inokawa, "in such a manner will cause at least some deformation of the tissue to occur because the skin is more pliable than the cover," such that the modified sensor and lens "acts to further deform the tissue of the user around the convex surface of the lens when the device is pressed against the tissue." Pet. 56; Ex. 1003 ¶ 145.

<u>Patent Owner's Arguments</u>

Patent Owner is of the view that Petitioner has not met its burden to demonstrate the obviousness of modifying Mendelson-1988's sensor in light of Inokawa to have a protrusion, based on substantially the same analysis and testimony discussed above in the context of combining Aizawa and Inokawa. *See* PO Resp. 46–50; Ex. 2004 ¶¶ 98–109; *supra* Section II.D.3.v. For example, Patent Owner argues that Mendelson-1988, like Aizawa, provides central emitters surrounded by several peripherally located detectors. *Compare* Ex. 1015, 169 (Fig. 2) (showing four central LEDs surrounded by six photodiodes), *with* Ex. 1006, Figs. 1(a)–1(b) (showing

one central LED 21 surrounded by four photodetectors 22); PO Resp. 46. Given this arrangement, Patent Owner reiterates its argument that the proposed combination in view of Inokawa would direct light away from the peripheral detectors, and toward the center of the sensor, thereby diminishing the received signal. PO Resp. 48–50.

Additionally, and as discussed above in the context of combining Aizawa and Inokawa, Patent Owner argues that Petitioner improperly relies upon Nishikawa's teachings, although Nishikawa is not identified as part of the asserted ground of unpatentability. PO Resp. 54–55.

Petitioner's Reply

Petitioner incorporates its contentions as set forth regarding the proposed combination of Aizawa and Inokawa, and responds that Dr. Kenny's consideration of Nishikawa was proper, as providing further support for the proposed combination. Pet. Reply 23, 26–27.

Patent Owner's Sur-reply

Patent Owner's Sur-reply generally reiterates its arguments challenging Petitioner's contentions. PO Sur-reply 20–24.

Analysis

As an initial matter, we find that a preponderance of the evidence establishes that the Mendelson-1988 sensor's optically clear epoxy is a light permeable cover that is arranged above a portion of the housing and covers the sensor's detectors.[8] In particular, it is clear from Figures 2A and 2B that the epoxy extends from the top of the sensor at the dotted line in the figure, down into the well of the AIRPAX package, to cover all four LEDs and all six photodiodes disposed at the bottom of the well. *See also* Ex. 1015, 168

[8] We note that claim 1 does not recite a "cover." *See supra* § II.A.1.

("The optical components were encapsulated inside the package using optically clear adhesive.").

We also conclude that a preponderance of the evidence supports Petitioner's contention that it would have been obvious to modify the top surface of Mendelson-1988's epoxy to include a lens including a single convex protruding surface, in order to increase the amount of backscattered light that will be received by Mendelson-1988's peripheral detectors. Our reasoning is substantially identical to the analysis provided above in connection with the ground based on Aizawa and Inokawa, with Mendelson-1988 replacing Aizawa in the combination. *See supra* Section II.D.3. Patent Owner does not cite, and we do not discern, any material difference between Mendelson-1988 and Aizawa that might lead to a different result here. For the reasons discussed in Section II.D.3, we do not agree with Patent Owner's arguments that the proposed combination would result in a diminished sensor signal, or that Petitioner improperly relied upon Nishikawa.

vi. Summary

For the foregoing reasons, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 1 would have been obvious over the cited combination of references.

3. Independent Claim 9

Independent claim 9 consists of limitations that are substantially similar to elements [a]–[d] of claim 1. *Compare* Ex. 1001, 44:50–67, *with id.* at 45:26–36 (reciting a "planar surface"; "at least four detectors" arranged in a "grid pattern" on the planar surface; and "a lens forming a

cover of the housing"). In asserting that claim 9 also would have been obvious over the combined teachings of Mendelson-1988 and Inokawa, Petitioner refers to substantially the same arguments presented as to claim 1. *See* Pet. 63–66; Ex. 1003 ¶¶ 160–165. Specifically, regarding the recitation of "a lens forming a cover of the housing," Petitioner maintains that "Mendelson-1988-Inokawa renders obvious" this limitation and incorporates its contentions from claim 1. Pet. 66; Ex. 1003 ¶ 165.

Regarding claim 9, Patent Owner largely relies upon arguments we have already considered with respect to independent claim 1. PO Resp. 46–56. Additionally, Patent Owner argues that Petitioner's proposed combination does not include the claimed "cover" because Mendelson-1988 encapsulates its components in optically clear adhesive/epoxy, which is not a "cover." PO Resp. 46, 51–52. Patent Owner contends that the '191 patent distinguishes between resin and covers. *Id.* at 51 (citing Ex. 1001, 36:50–60). Patent Owner also argues that Nishikawa, on which Petitioner relies, "never identifies its resin as a cover," and instead "discusses encapsulation of components using an integrally molded resin." *Id.* at 52 (citing Ex. 1023 ¶ 35). Likewise, Patent Owner characterizes Inokawa's cover as a "***distinct structure***, not an undifferentiated mass of resin on a surface." *Id.* (citing Ex. 1008 ¶ 103).

Patent Owner's argument, however, is premised on its proposed claim construction of the term "cover" as excluding resins and epoxies. *Id.* For reasons provided in Section II.A.1 above, we do not find that claim construction persuasive, and Patent Owner does not distinguish the prior art from claim 9 on this basis.

Thus, for the same reasons discussed above, we determine that Petitioner has met its burden of demonstrating by a preponderance of the evidence that claim 9 would have been obvious over the cited combination of references. *See supra* II.E.2.i–v; Ex. 1003 ¶¶ 160–165.

4. Dependent Claims 2–6, 8, 10–16, 18, and 19

Petitioner presents undisputed contentions that claims 2–6, 8, 10–16, 18, and 19, which depend directly or indirectly from independent claim 1 or 9, are unpatentable over the combined teachings of Mendelson-1988 and Inokawa, and provides arguments explaining how the references teach the limitations of these claims. Pet. 56–63, 66–70; Ex. 1003 ¶¶ 146–157, 166–175.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1. PO Resp. 56 ("The Petition fails to establish that independent claims 1 and 9 are obvious . . . and therefore fails to establish obviousness as to any of the challenged dependent claims.").

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2–6, 8, 10–16, 18, and 19 would have been obvious over the combined teachings of the cited references and as supported by the testimony of Dr. Kenny.

F. Obviousness over the Combined Teachings of Aizawa, Inokawa, and Ohsaki

Petitioner contends that claims 1–6, 8–16, 18, and 19 of the ’191 patent would have been obvious over the combined teachings of Aizawa, Inokawa, and Ohsaki. Pet. 43–46.

Because we have already determined that these claims are unpatentable based on Aizawa and Inokawa, and based on Mendelson-1988 and Inokawa, which are dispositive as to all challenged claims, we need not reach this additional ground. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) ("[T]he Board need not address issues that are not necessary to the resolution of the proceeding."); *see supra* §§ II.D–E.

III. CONCLUSION

In summary:[9]

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–6, 8–16, 18, 19	103	Aizawa, Inokawa	1–6, 8–16, 18, 19	
1–6, 8–16, 18, 19	103	Mendelson-1988, Inokawa	1–6, 8–16, 18, 19	
1–6, 8–16, 18, 19	103[10]	Aizawa, Inokawa, Ohsaki		
Overall Outcome			1–6, 8–16, 18, 19	

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that claims 1–6, 8–16, 18, and 19 of the ’191 patent have been shown to be unpatentable; and

---

[9] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

[10] As explained above, because we conclude that the challenged claims are unpatentable on other grounds, we do not reach the merits of this ground.

FURTHER ORDERED that, because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

For PETITIONER:

Walter Renner
Andrew B. Patrick
Hyun Jin In
Roberto DeVoto
FISH & RICHARDSON P.C.
Axf-ptab@fr.com
PTABInbound@fr.com
in@fr.com
devoto@fr.com

For PATENT OWNER:

Joseph Re
Jarom Kesler
Stephen Larson
Jacob Peterson
KNOBBE, MARTENS, OLSEN, & BEAR, LLP
2jrr@knobbe.com
2jzk@knobbe.com
2slw@knobbe.com
2jup@knobbe.com